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Farm forestry and tree culture projects for the non-forested region of Manitoba.

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FOR THE

Non-Forested Region of Manitoba

A Report prepared for the
Post-war Reconstruction Committee of the
Government of Manitoba
by Advisory Committee on Woodlots
and Shelterbelts

OCTOBER 1945

J. H. ELLIS, Soils Dept., The University of Manitoba, *Chairman*
C. B. GILL, *Chief,* Forest Management, Manitoba Government
F. W. BRODRICK, Horticulturist, *Secretary*

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Farm Forestry

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PREFACE

THIS report on Farm Forestry and Tree Culture Projects for the non-forested regions of Manitoba was undertaken with a view to providing a comprehensive picture of the natural possibilities of, and the limitations to, tree production in the prairie and aspen grove regions of Manitoba.

Based on the natural possibilities and limitations of the soil, and having in mind the various specific and local needs of the different soil and landscape areas, there is herein outlined a long time program of public, semi-public and private projects as the basis of a provincial farm forestry and tree culture development.

Various activities are advocated, including improvement of farm woodlots; the afforestation of sandy areas; the development of demonstration woodlots; the establishment of field shelterbelts; the investigation of problem areas; and the co-operative marketing of farm forest products, as well as other activities. Consideration also has been given to the use of trees for combatting the detrimental effect of wind and water erosion.

Valuable co-operation has been rendered by Dominion and Provincial officials, and by others, in providing certain historical and factual material included in this report; where this material is used, the source is recorded. Thanks are especially due to C. H. Spurway, Michigan, for permission to select data from his compilation of "Soil Reaction Preferences of Plants"; to J. J. Zaylskie, North Dakota; to J. A. Cope, New York; and to E. S. Pierce, E. L. Demmon and R. A. Williams, United States Federal officials, and others, for much information courteously supplied; this information has been freely used and is herewith gratefully acknowledged.

It is hoped that this report may be a useful guide in determining future land use policies; that it will serve to focus attention on the need for a program designed to make the best use of non-arable lands in the agricultural part of Manitoba; and that it will lead to a common understanding of the fundamental problems connected with tree culture in the prairie and aspen grove regions.

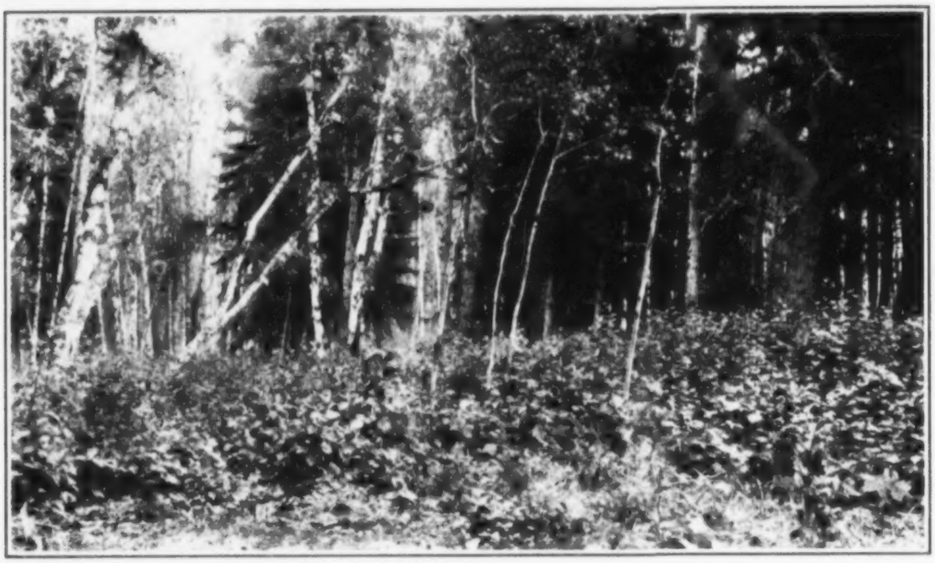

ILLUSTRATION No. 1

A favorable soil or "growth site," both for tree production and regeneration, is here indicated by the natural stand of variable-aged deciduous and coniferous trees and by the young undergrowth. Good woodlot management is shown by the protection of the natural growth from injury by fire and livestock.

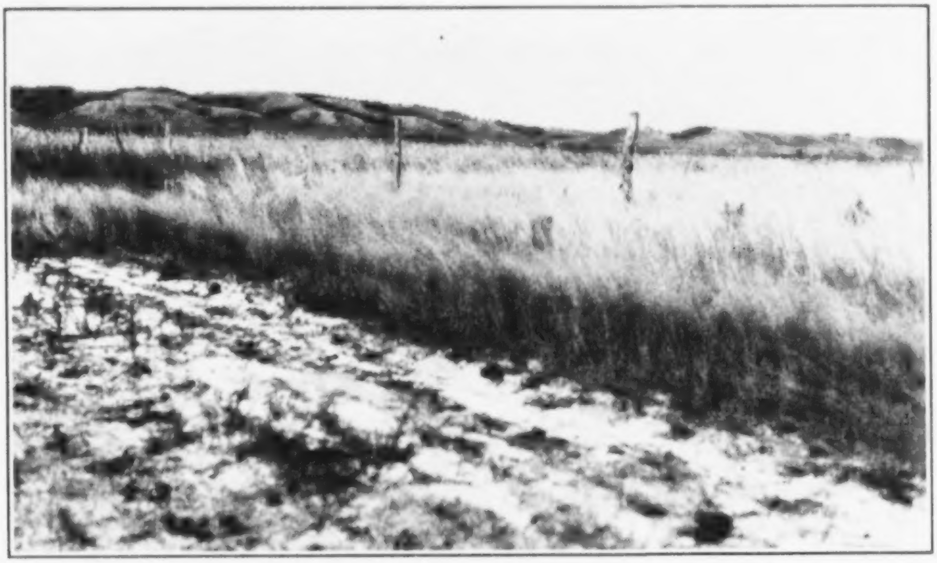

ILLUSTRATION No. 2

Unfavorable soils or "growth sites" for the production of trees are here indicated. The sparse grass and artemisia covered slopes in the background are droughty, due to light precipitation, high run-off, and southern exposure; aspen and oak which are quite scrubby here occur only in the narrow ravines where trapped snow provides additional moisture. Tree growth in the valley flats of the foreground is inhibited by the same and alkaline soil conditions. (Lang's Valley, southwest Manitoba.)

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SYNOPSIS

1. The need of protection for home and building sites, and the desire for beautification, were the primary incentives that initiated the pioneer establishment of farmstead shelterbelts or windbreaks on the farms in the prairie and aspen grove regions. With the passage of time, other needs for tree culture, such as soil conservation, land utilization, and run-off control, have become more and more apparent, and the needs more and more urgent. Hence, a new and enlarged utility program of farm forestry and tree culture is required to meet the varied needs in the non-forested portion of the prairies.

2. The enlarged utility program of farm forestry and tree culture herein recommended includes: the development of natural woodlots; the afforestation of certain sandy areas unsuited for agricultural use; the establishment of field shelterbelts in specific areas for soil and water conservation; the planting of trees and shrubs for the protection of highways, drainage ditches, dugouts, and other earthworks; the development of recreational areas, picnic grounds, and scenic highways along tourist routes; and the renovation and extension of farmstead shelterbelts and town and village plantings, etc. These utility projects also would provide protection for wild life and contribute vastly to the beautification of the countryside.

3. No plan to initiate or enlarge a farm forestry and tree culture program in the grassland and aspen grove region should be undertaken until the natural possibilities and limitations are understood. The native vegetation which prevails as the result of natural experimentation for thousands of years is unmistakable evidence, that, whereas specific species of trees thrive in the "Boreal" and in the "Lakes" forest regions, the production of trees is more and more handicapped as the comparatively moist soil climate of the forest gives place to the drier soil climate of the prairie region, and the still drier soils of the steppe regions.

4. The chief causes of the failure of trees to develop and to reproduce naturally in the normal positions of the grassland regions may be listed as: unfavorable conditions resulting from regional atmospheric droughts; local soil drought; and adverse or alkaline soil reaction. In addition, the lack of mother trees to produce seed is responsible for the general absence of coniferous trees on certain favorable sites which do occur in the prairie and aspen grove regions.

5. Growth site conditions, which naturally favor the development of trees in the grassland and aspen grove regions, occur as the result of local humidity or locally moist soil conditions, such as are found in:

(*a*) Sites with locally moist atmospheric climate due to relatively higher altitudes.

(*b*) Sites with locally humid soil climates as found (1) on the northern and eastern exposures of morainic hills, ravines and riverbanks; (2) in deep ravines and depressions; (3) on the higher altitudes, the northern and eastern slopes, and the bench lands of the Manitoba escarpment; (4) the ring-like intermediately drained positions surrounding the depressions in the prairie; (5) in river valleys, river terraces, and flood plains; (6) as sandy deposits with moist substrata; and (7) in the transitional areas adjacent to the forest in the more humid portions of the tall grass prairie.

(*c*) Sites which are regionally low in lime or developed on non-calcareous shale drift.

6. It must be recognized that the problems incident to tree culture in the grassland regions are real. Here the successful production of trees depends primarily upon the selection of suitable growth sites, but also upon the right species and the right types of trees; upon the proper care and management of suitably laid out projects; upon harvesting when the crop is mature; and upon regeneration or replacement as required to insure sustained yield.

7. Familiarity with local and regional needs, together with a knowledge of the soil, the climate and native vegetation (local as well as regional), and of the natural limitations to, and possibilities of tree production in the various landscape areas, as well as of the characteristics and growth site requirements of the various tree and shrub species that may be used, are essential to the successful planning of suitable farm forestry and tree culture projects in the grassland and aspen grove regions. The conditions, characteristics and problems from a farm forestry and tree culture standpoint in Manitoba by regions, soil zones, landscape areas, and soils, are outlined in the text of this report.

8. A summary of suitable farm forestry and tree culture projects recommended for the various soil and landscape areas, based on the findings of the Manitoba Soil Survey is given in tabular form.

9. A summary of the characteristics, requirements and uses of trees and shrubs recommended for forestry and tree culture projects in Manitoba has been prepared and is herein presented for reference purposes.

10. It is estimated that there are approximately 875,000 acres of natural woods under various conditions in the prairie and aspen grove region of Manitoba where private or municipal woodlots could be established, maintained, and improved. In addition, there are approximately 464,000 acres of dunes and light sands, unsuited for agriculture, which are suitable for afforestation to spruce and pine. Thus there are some 1,339,000 acres of land on which farm and community forests and woodlots could be developed.

11. It is recommended that representative blocks of each of the various types of natural woods in the prairie and aspen grove region be set aside as farm forest demonstration areas, and also that farm demonstration woodlots be established with co-operating farmers.

12. (*a*) It is estimated from soil survey records that there are 1,456,000 acres of land in the Souris and Agassiz basins in which the soils are susceptible to wind erosion due to sandy texture or feeble structure, and on which immediate steps to control soil drifting are required. These soils are good growth sites for trees, and field shelterbelts are strongly recommended. The systematic use of field shelterbelts to give adequate coverage on these light soils would require 27,300 miles of tree and shrub hedges. In addition, there are 1,098,000 acres of good arable soils developed on sorted parent materials that are less susceptible to wind erosion, but on which field shelterbelts could be introduced as a preventive or soil conservation measure. This would require an additional 20,580 miles of shelterbelt hedges, thus giving an ultimate possible requirement of 47,880 miles of field shelterbelts and hedges that could be established to aid in the control of soil drifting.

(*b*) It is also recommended that, in specific areas, field shelterbelts of natural and planted material be developed on the contours of cultivated fields for the purpose of soil and water erosion control. These areas include the stronger slopes in the Turtle Mountain, the Tiger Hills, the various sections of the Manitoba escarpment, the west slopes of Riding Mountain, and local areas of rolling phase Carroll and other soil associations. No estimate is given of the miles of hedges and shelterbelts required because, in many cases, the necessary protection can be obtained by judicious use of native tree and shrub growth.

13. To supply the large number of seedlings that would be required if the extensive field woodlot and shelterbelt programs (referred to in Items 10 and 12) are to be undertaken, it will be necessary to provide adequate and suitable farm forest nursery facilities. It is recommended that the necessary provincial farm forestry nurseries be established in strategical locations. (It would be logical to put these farm forestry nurseries under a provincial farm forestry unit or branch. See Item 15.) This production of utility stock for provincially sponsored projects would not take the place of planting stock now being supplied for existing projects by Federal and private enterprise. The latter agencies may be expected to fulfill the same function and supply the same needs in the future as they have done in the past.

14. In addition to the development of farm forests and woodlots as a land utilization measure, and of field shelterbelts for soil and water conservation, it is pointed out that encouragement and co-operative assistance should be given to the enlarged program of tree culture needed in connection with highway and roadside plantings, scenic highways, picnic grounds, tourist parks, town and village plantings, farmstead shelterbelts, and the protection of dugouts and drainage ditches.

15. To implement the woodlot and field shelterbelt programs outlined, and to insure a co-ordination and continuity of action, it is essential that a farm forestry and tree culture unit or branch be appointed and attached either to an appropriate government department or the University. This unit should be given adequate support. Such a unit or branch is needed to plan and put into operation the woodlot and field shelterbelt projects required; to demonstrate in a practical way the most suitable and profitable silvicultural practices on demonstration areas of typical natural woodlots; to establish co-operative demonstrational woodlots on individual farms; to act as advisors in woodlot management; to organize and assist in the establishment of field shelterbelt projects; to conduct investigational and educational campaigns; to give leadership, to extend co-operation, and to supply technical supervision and advice in the development of new and enlarged programs of tree culture in the non-forested area, and in the co-operative marketing of farm forest products.

16. The task of planting, and the subsequent care and management of the respective tree culture projects involve labor, supervision, and management, that will be variously provided, depending on the private or public nature and magnitude of the different projects.

17. Tree culture information of historic and academic interest, and a review of state action to foster farm forestry in Canada and the United States, is presented in an appendix.

FARM FORESTRY AND TREE CULTURE PROJECTS FOR MANITOBA FARMS

I. INTRODUCTION

From the earliest days of settlement on the Manitoba prairies to the present time, attempts to establish trees have been undertaken with varying degrees of success. Under pioneer conditions it was inevitable that those settlers who came to the open grasslands from eastern Canada and western Europe should feel keenly the marked contrast between the old home sites (surrounded and protected by trees or forest), which they had left, and the new home sites, (surrounded by wide expanses of wind-swept prairie), to which they had come. The physical need to ameliorate the bleak environment of the dwellings, and the aesthetic desire for more attractive home sites, were primarily responsible for the early practice of planting shelterbelts or windbreaks around farm homes, building sites and gardens. The extent to which this practice became general is evidenced by the relatively large number of such windbreaks, good, bad and indifferent, that mark the location of many well-established farm homes in the prairie region. As the years went by, intermittent interest and activity also developed in the planting of trees along the village streets or town boulevards, and in school grounds, cemeteries, memorial parks, etc.

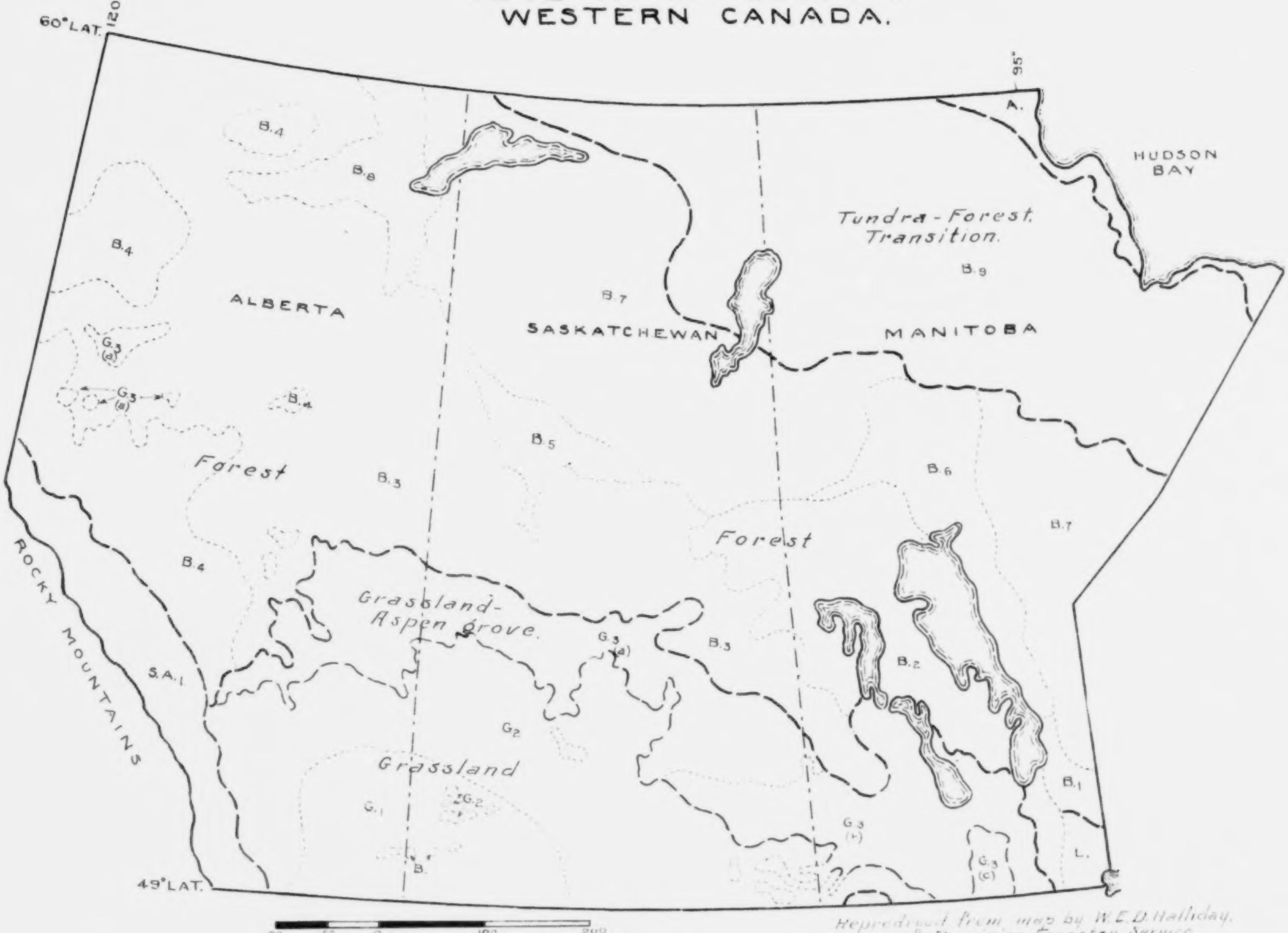
The maximum advantages from the earlier farmstead shelterbelts, and the town and village plantings, however, in many cases, were not always secured, partly because the problems in connection with tree culture in the open plains are real, (so that tree planting is beset with hazards), and partly because of the fact that the tree species available or chosen were not always adapted to the local growth sites. Nevertheless the citizens of Manitoba owe a debt of gratitude to those who, (by their pioneer endeavors early in the economic development of the prairies), demonstrated in a measure what may be accomplished and what should be avoided. The point to be emphasized is that the pioneer experiments in tree culture on prairie farms were undertaken because of recognized human needs. In brief, the need for the protection of home sites, coupled with the desire for beautification, was the primary incentive for the establishment of farmstead shelterbelts or windbreaks.

The concept of tree culture in Manitoba however has gradually become enlarged as other needs, such as soil conservation, land utilization and water conservation, became more and more apparent. In this enlarged concept, specific trees can be made to serve many utilitarian purposes. As a crop under an afforestation program, in favorable growth sites, trees may be grown in private or municipal woodlots to insure economic utilization of lands that may be submarginal for arable agricultural use; they may be grown as field shelterbelts to protect light textured soils from wind erosion and growing crops from damage; they may serve on the stronger slopes and steep ravines in the conservation and protection of soil from wind and water erosion; they may be used to retard run-off and thus aid in water conservation; they may be planted as snow traps to insure a supply of water in dug-outs and gardens; they may be used as hedges and shelterbelts for the protection of roadways, ditches, and other earthworks; and in addition, they may be used in the protection and preservation of wild life, game, etc., as well as for the aesthetic purposes that are more generally stressed by Arbor Day enthusiasts.

However, no matter what other purposes trees may serve on prairie farms, they should be considered as a productive crop. To obtain best results with trees as a wood crop, the same principles apply and the same common-sense treatment is required that is necessary in the production of any other crop. Success depends upon the selection of the right sites, the right species, and the right types; upon the proper care and management of suitably laid out projects; upon harvesting when the crop is mature; and upon regeneration or replacement as required to insure sustained yields.

FIGURE No. 1

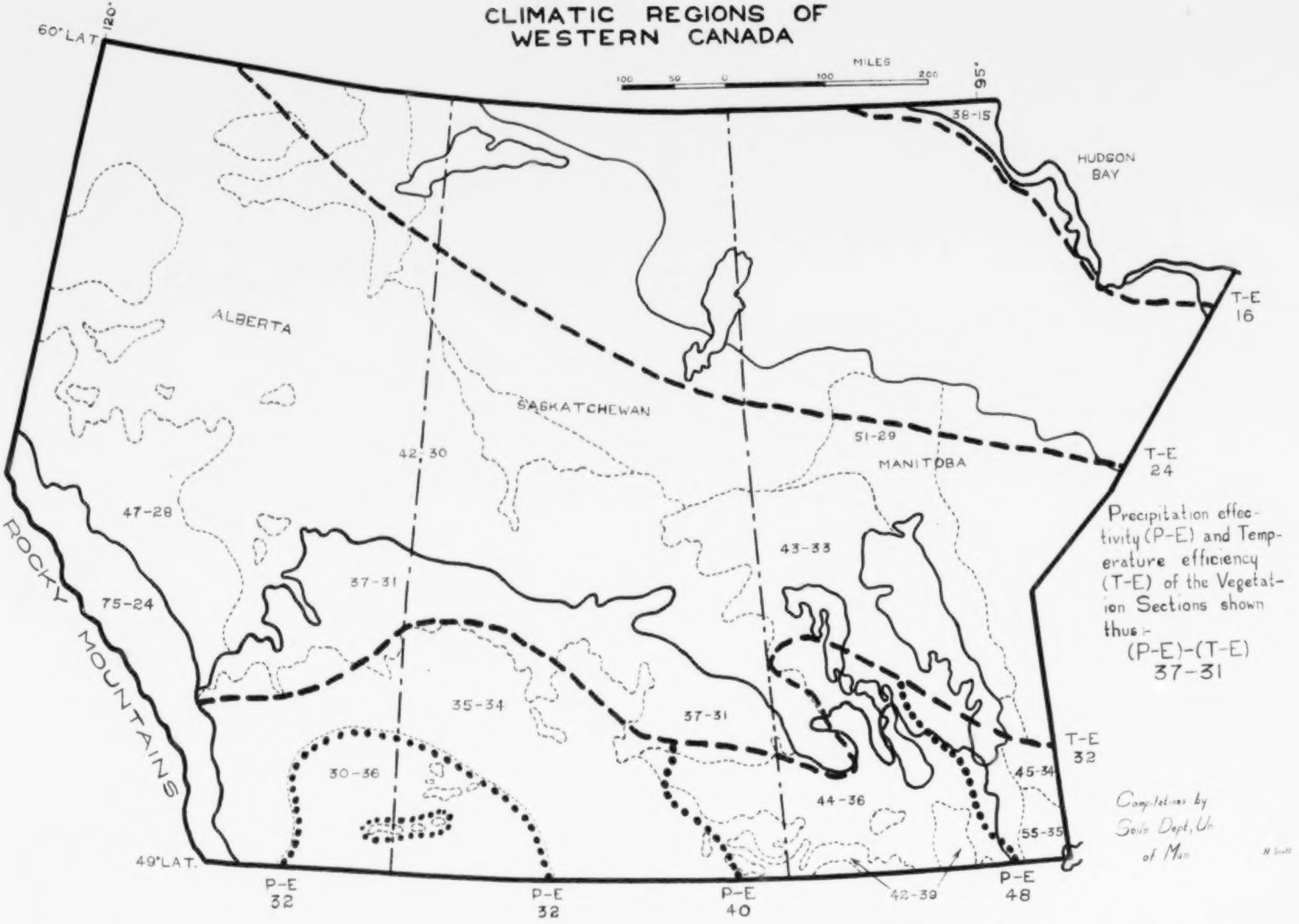
VEGETATION BELTS OF WESTERN CANADA.


60° LAT.
120°
95°
49° LAT.
HUDSON BAY
ALBERTA
SASKATCHEWAN
MANITOBA
ROCKY MOUNTAINS
Tundra-Forest Transition.
Forest
Forest
Grassland-Aspen Grove.
Grassland
A.
B.1
B.2
B.3
B.3
B.4
B.4
B.4
B.4
B.5
B.6
B.7
B.7
B.8
B.9
G.1
G.2
G.2
G.3 (a)
G.3 (a)
G.3 (a)
G.3 (c)
S.A.1
L.
B.
MILES
50
0
100
200

Reproduced from map by W.E.D. Halliday, of Dominion Forestry Service.

FIGURE No. 2

CLIMATIC REGIONS OF WESTERN CANADA


60° LAT.
120°
95°
MILES
100 50 0 100 200
38-15
HUDSON BAY
ALBERTA
SASKATCHEWAN
MANITOBA
51-29
42-30
47-28
43-33
37-31
75-24
ROCKY MOUNTAINS
35-34
37-31
30-36
44-36
45-34
55-35
42-39
T-E 16
T-E 24
T-E 32
49° LAT.
P-E 32
P-E 32
P-E 40
P-E 48

Precipitation effectivity (P-E) and Temperature efficiency (T-E) of the Vegetation Sections shown thus:-

(P-E)-(T-E)
37-31

Compilation by Soils Dept, Un of Man

H Scott

II. NATURAL LIMITATIONS TO TREE DISTRIBUTION AND DEVELOPMENT

As pointed out in the preceding paragraphs, many reasons may be given why there should be an enlarged program of tree culture in the grassland region of Manitoba, but before any attempt is made to outline suitable projects that can be recommended wisely, it is imperative that a few fundamental facts be reviewed in order that the elements of the tree culture problems on the prairies may be recognized.

The establishment of the native vegetation, under virgin conditions prior to settlement in western Canada, was not the result of chance occurrence, but of the suitability of the occurring plant species to the existing environment. Thus the presence of forest vegetation in one region, and of open grassland in another, was Nature's evidence of the long-time harmonious adjustment between the vegetation, the soils and the climate.

A generalized picture of the native tree and grassland vegetation of western Canada is shown by the sketch map presented as Figure No. 1. This figure however, shows a generalized, not a detailed picture. The generalized picture of native vegetation shows that tundra, forest, and grassland occur in belts. A detailed picture would show that within each belt, islands of other types of vegetation occur on favorable local growth sites, because of local variation in soils and soil climate within the grassland region (especially in the zone of stress between grassland and forest). Therefore local treed areas can and do occur as occluded islands surrounded by regional grassland vegetation.

It is here emphasized further that the various patterns of native tree distribution in western Canada are the result of thousands of years of natural experimentation. This is equally true whether the pattern assumes the form of a broad continuous belt in the forest region, or occurs as intermittent tree islands and ribbon-like strips of woods along the streams and ravines in the grassland region. The lessons of this natural experiment should be given due consideration.

In cultural attempts to replace the grass vegetation with trees, it is a wise procedure first to ascertain the reasons why particular growth sites are occupied by specific types of vegetation. In other words, before attempts are made to produce trees in a given site in the future, it is profitable to ascertain why trees did or did not become established there in the past.

The factors affecting the distribution of vegetation, and the possibilities or otherwise of successful tree production are outlined in the following pages. These factors are the basis of the farm forestry and tree culture programs recommended in later portions of this report.

A. Climate:

In the final analysis the most important factor in the distribution of vegetation is climate, either as it affects plants directly, or as it affects and determines the soil type.

A few explanatory notations in respect to climate should be considered at this point. "Atmospheric climate" is made up of a number of factors, i.e., wind, sunshine, precipitation, temperature, etc., each of which may be studied individually and expressed scientifically. "Soil climate" however is difficult to define by scientific or mathematical measurements. Soil climate is the end result of the sum of all its variable components, (i.e., temperature, moisture, etc.), and the end results of the soil climate are expressed in each particular site by the genetic soil type developed, and by the vegetation produced.

Therefore in considering the question of climate and tree culture in the non-forested area, it is important to keep in mind that trees (like all other vegetation) are under the influence of both "atmospheric" and "soil" climate. While atmospheric climate may be fairly uniform over a large area, the soil climate (and consequently the soil type and the vegetation) may vary widely within very limited areas, due to variations in topography and relief; to exposure and slope; to external and internal drainage; and to coarseness or fineness of the soil texture, etc.

The closeness of the zonal vegetation pattern shown in Figure No. 1 to the regional climatic pattern is strikingly shown in Figure No. 2. It is recognized of course, that the meteorological data available for the three provinces are somewhat inadequate in view of the large area involved, and of the limited data which cover only a relatively short period of years. This is especially true of the central and northern portions. However, if the available climatic data are calculated and expressed as "precipitation effectivity" and "temperature efficiency" indices*, (Table No. 1), the available meteorological data show a very close relationship to the various regional climates indicated by the native vegetation.

As shown in Figure No. 2, the "temperature efficiency" index isopleth (or line) of 32 (T/E 32) crosses the three provinces from west to east and marks a critical boundary. North of this line, temperature is the dominant controlling climatic factor. Between the "temperature efficiency" indices of 32 (T/E 32), and 24 (T/E 24), there is an extensive belt of continuous boreal forest, except in the zone of stress occurring in the southern portions of this belt in Saskatchewan and Alberta, and here aspen groves and tall prairie grassland are intermixed.

South of the "temperature efficiency" index isopleth (or line) of 32 (T/E 32), moisture is the dominant controlling factor. Short grass and associated plant species occur when the "precipitation effectivity" index is around 32 (P/E 32) or less. Mixed short- and tall-grass species occur where the "precipitation effectivity" index is between 32 (P/E 32) and 40 (P/E 40). Groves of aspen and oak, in association with tall prairie grassland vegetation (G_3 (b), Fig. No. 1) are found where the "precipitation effectivity" is between 40 (P/E 40) and 48 (P/E 48), in contrast to the aspen groves without the oak in the zone of stress called the park belt of Saskatchewan and Alberta (G_2 (a), Fig. No. 1), where both the "precipitation effectivity" and the "temperature efficiency" indices are somewhat lower.

When the "precipitation effectivity" index is over 48 (P/E 48) in the eastern part of Manitoba, the grassland and aspen grove gives place to forest, but the "temperature efficiency" index of 32 (T/E 32) is again a critical line, because "Boreal Forest" of white spruce, black spruce, balsam fir, tamarack, jack pine, aspen, balsam poplar and paper birch occur to the north, but the forest to the south contains in addition such tree species as white and red pine which are characteristic of the "Lakes Forest."

Thus Nature herself gives visible evidence that certain species of trees thrive in the "Boreal" and in the "Lakes Forest" regions, but the production of trees is more and more handicapped as the comparatively moist climate of the forest gives place to that of the "Prairie" and the still drier "Steppe."

In the "Steppe" and "Prairie-steppe" regions, the primary tree inhibiting factor has been the severe periodic atmospheric droughts which are unfavorable both for the growth and the natural reproduction of trees. In the "Prairie-aspen grove" region, the regional atmospheric climate is at the point of balance between grassland and forest tolerance, so that the normal and locally dry topographical positions are occupied by prairie, but the locally humid and less well drained positions (if not saline) are occupied by a limited development of the specific native trees that can reproduce and grow on such growth sites.** In the forest region, trees are dominant because the prevailing climatic conditions favor not only tree growth, but also the reproduction of a wider range of tree species that can reproduce naturally only under forest conditions.

B. Soil Type and Soil Reaction:

Soils are also a limiting factor in tree distribution.

There is an interdependence between soils, climate, and vegetation. Native vegetation is determined by climate and by soil type. In turn, soils reflect the climate and the vegetation under which they were produced. The climate through recent geological times determined the native vegetation which was produced; the native vegetation, in turn, determined the type of organic matter deposited within or on the soil. The climate also determined the rate and degree of weathering of the soil minerals, the rate of production and decomposition of

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*See Appendix to "A Forest Classification for Canada," Dominion Forest Service, Bulletin 89. Canada Dept. of Mines and Resources.

**See Appendix 8.

TABLE NO. 1—PRECIPITATION EFFECTIVITY AND TEMPERATURE EFFICIENCY OF THE VEGETATIVE AREAS IN WESTERN CANADA

(P-E=Precipitation Effectivity, T-E=Temperature Efficiency)*

No.	Climax and Section	No. of Stations	Annual P-E Index	Annual T-E Index	P-E Index		Per Cent. T-E Concentration Three Summer Months	Climatic Province
					Three Summer Months	Three Winter Months		
A.	TUNDRA CLIMAX (Arctic)							
	Fort Churchill	..	37.7	15.3	13.7	4.6	84.9	Cd E'd
	GRASSLAND CLIMAX							
G. 1	Short-Grass Prairie	9	29.7	36.3	10.2	7.5	62.1	Dd C'c
G. 2	Mixed Prairie	35	34.9	33.7	11.6	8.7	62.8	Cd C'c
G. 3(a)	Tall-Grass Prairie and Aspen-Grove	25	37.5	31.0	13.2	8.8	64.1	Cd D'c
G. 3(b)	Tall-Grass Prairie and Aspen-Oak	22	43.5	36.0	13.0	10.7	63.4	Cd C'c
G. 3(c)	Tall-Grass Prairie and Meadow-Prairie	3	45.4	38.9	12.3	11.4	65.5	Cd C'c
	LAKES FOREST REGION							
L.	Rainy River Section	4	54.9	35.2	14.8	13.4	64.5	Cr C'c
	BOREAL FOREST REGION							
B. 1	English River Section	1	44.8	34.5	10.8	13.8	64.9	Cd C'c
B. 2	Manitoba Lowlands	4	43.4	32.6	11.9	11.5	67.1	Cd C'c
B. 3	Mixed Woods Section	13	41.9	30.4	14.3	10.9	63.8	Cd D'c
B. 4	Foothills Section	7	46.8	28.0	15.1	12.2	62.7	Cd D'c
B. 5	Hyper-Churchill	None	....	....	....	....	....	......
B. 6	Nelson River Section	2	50.7	29.3	12.9	14.6	70.5	Cr D'd
B. 7	Northern Coniferous	None	....	....	....	....	....	......
B. 8	Mackenzie Lowlands Section	6	33.6	24.3	9.1	8.7	75.7	Cd D'd
B. 9	Northern Forest-Tundra Trans.	1	54.1	18.8	18.3	10.9	81.9	Cr D'd
	SUB ALPINE FOREST REGION							
SA. 1	East Slope Rockies Section	4	57.2	26.6	14.5	18.8	63.8	Br D'c

*Thornthwaite values.

organic matter, the extent to which the products of weathering were accumulated in, or removed from, the soil profiles, and it determined the soil reaction which developed in consequence. Moreover, the soil reaction, whether acid, neutral, or alkaline, was an important factor in determining the species of plants that were developed, and the type of organic matter produced and deposited in or on the soil. Thus, as might be expected, the typical soils of the various soil zones have developed characteristics which reflect both the regional climatic conditions and the vegetation under which they were produced.

Because climate and vegetation together have influenced the soil types (or soil groups) which have developed, and because regional climate and regional vegetation occur in geographic belts, the major regional soil types (or groups) of western Canada also occur in geographic or regional belts.

However, between each of the regional soil zones, there are areas of transitional soils, and within each zone there are several sub-zones and intrazonal soil types.

Despite the fact that in each soil zone and sub-zone a specific soil type will be dominant, there is within each zone an intricate pattern of soil and plant variation. There are many variations in soil due to variations in texture, in mineralogical composition of the soil parent materials, and in depth of root room or depth to the underlying rock; there are variations in local or intrazonal soil types due to variations in local soil climate brought about by differences in altitude, topography, drainage, and physical characteristics of the mineral parent materials, as well as differences in degree of expression because of differences in age.

The zonal and intrazonal relationship of soils in western Canada and their natural suitability for tree growth is indicated in summary Table No. 2.

The fundamental relationship that exists between regional soil forming processes, soil type, soil climate and native vegetation is further indicated in Figure No. 3. This figure shows that the soil forming processes are controlled by the circulation of water in the soil profile. The relative amount of water that normally penetrates into the soils is indicated by the relative depths to which the differentially soluble products of weathering accumulate. In the soil profiles shown at left (Fig. No. 3), the water which penetrates into the soil from above is, in effect, equalled by the amount used by plants or lost from the soil by evaporation. Hence there is no surplus of water to remove the products of weathering down into the substrata.

Figure No. 3 also shows that as the amount of water entering the soil increases, the products of weathering are carried further downwards in the soil. When more water percolates through the soil than is used by plants or lost by evaporation, the soluble products of weathering are leached into the substrata. Thus, with increase in humidity, the soils first become less and less alkaline, and then more and more acid. With increase in water percolation there is an increase in decomposition of minerals, a decrease in base adsorption, an increase in adsorbed hydrogen (or acidity) and an increase in illuviation or downward movement of clay from the surface (A) horizon to form a compact sub-surface or (B) horizon.

Changes in vegetation accompany changes in soil type and soil reaction. This is also shown in Figure No. 3. On the soils that are alkaline to neutral in reaction, the vegetation is steppe, prairie-steppe, and prairie. On the soils that are neutral to acid in reaction, the vegetation is usually aspen-grove and forest.

C. Conditions Unfavorable for Growth and Reproduction of Trees:

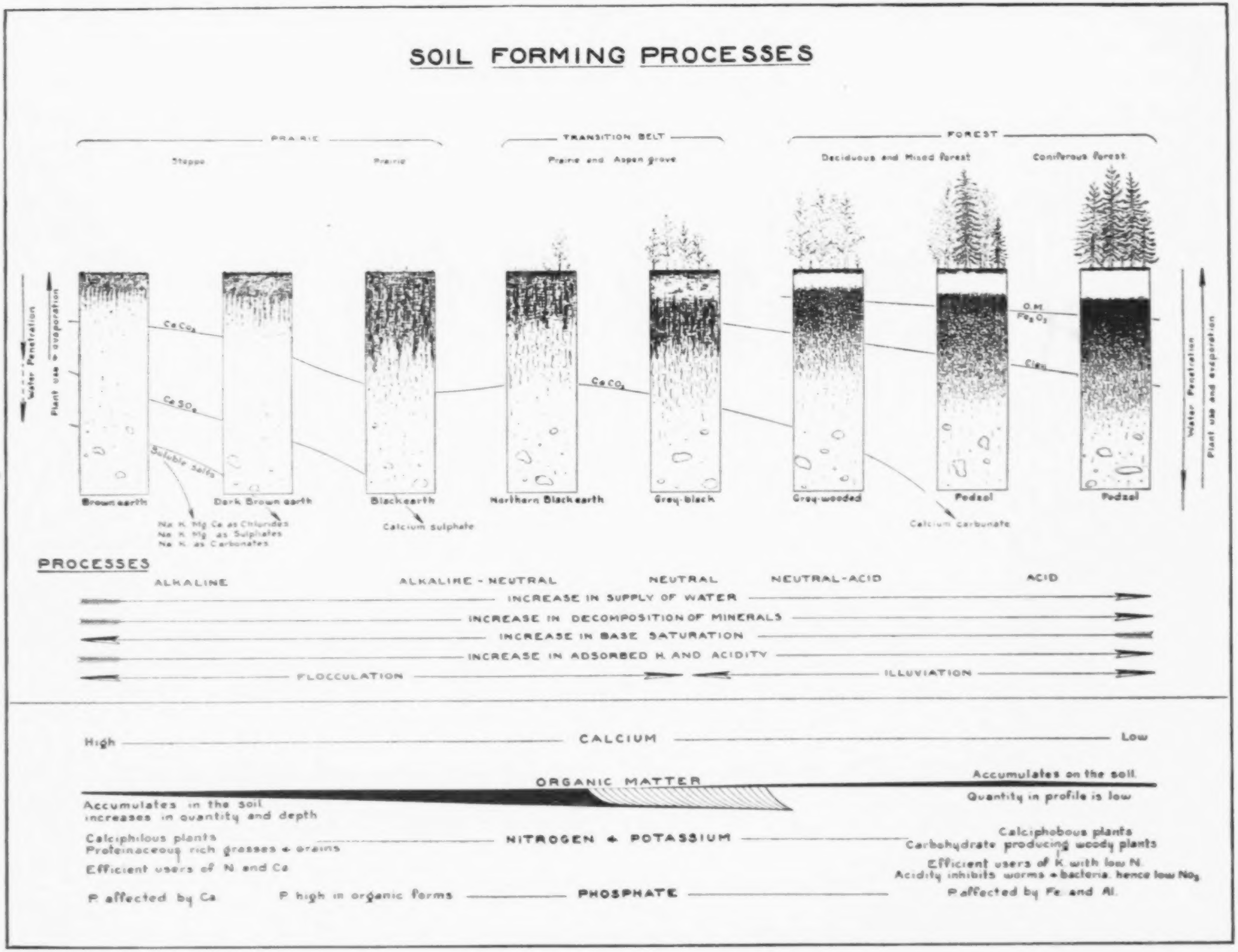
The effect of climate and soils in limiting the natural distribution of trees may be summarized by listing the adverse conditions under two headings, i.e., conditions that are unfavorable for the *growth* of trees, and conditions that are unfavorable for the natural *reproduction* of trees.

(1) CONDITIONS THAT ARE UNFAVORABLE FOR TREE GROWTH:

(*a*) *Regional drought:*

Severe periodic atmospheric droughts (according to their severity) periodically check growth; cause trees to die back; prevent normal maturity; and result in the premature death

FIGURE No. 3



SOIL FORMING PROCESSES

PRAIRIE
Steppe
Prairie
TRANSITION BELT
Prairie and Aspen grove
FOREST
Deciduous and Mixed forest
Coniferous forest
Water Penetration
Plant use + evaporation
$CaCO_3$
$CaSO_4$
Soluble salts
$CaCO_3$
O.M
Fe_2O_3
Clay
Brown earth
Dark Brown earth
Blackearth
Northern Blackearth
Grey-black
Grey-wooded
Podzol
Podzol
Na K Mg Ca as Chlorides
Na K Mg as Sulphates
Na K as Carbonates
Calcium sulphate
Calcium carbonate
PROCESSES
ALKALINE
ALKALINE - NEUTRAL
NEUTRAL
NEUTRAL-ACID
ACID
INCREASE IN SUPPLY OF WATER
INCREASE IN DECOMPOSITION OF MINERALS
INCREASE IN BASE SATURATION
INCREASE IN ADSORBED H AND ACIDITY
FLOCCULATION
ILLUVIATION
High
CALCIUM
Low
ORGANIC MATTER
Accumulates on the soil.
Quantity in profile is low
Accumulates in the soil
increases in quantity and depth
Calciphilous plants
Proteinaceous rich grasses + grains
Efficient users of N and Ca
NITROGEN + POTASSIUM
Calciphobous plants
Carbohydrate producing woody plants
Efficient users of K with low N.
Acidity inhibits worms + bacteria, hence low NO_3
P affected by Ca
P high in organic forms
PHOSPHATE
P affected by Fe and Al.

Table No. 2—Zonal and Intrazonal Relationship of Soils in Western Canada and their Natural Suitability for Tree Growth

Vegetation Region	Soil Zone and Soil Types*	Reaction of Typical Soil Members	Natural Suitability for Trees
Short-grass steppe.	*Zonal soils.*		
	Light brown to brown steppe.	Alkaline.	Unfavorable (re drought).
	Locally humid soils—		
	Halormorphic associates.	Alkaline.	Unfavorable (re salinity).
Mixed short-grass and tall-prairie grass or prairie-steppe.	*Zonal soils.*		
	Brown to dark brown steppe.	More or less alkaline.	Unfavorable (re drought).
	Locally humid soils—		
	Halomorphic associates.	Alkaline.	Unfavorable (re salinity).
Tall-prairie and aspen-grove.	*Zonal soils.*		
	Blackearths.	Neutral to slightly alkaline.	Hazardous to seeds and seeding but moderately favorable for growth when established.
	Associated soils—		
	Northern blackearth.	Neutral (slightly acid to slightly alkaline).	Moderately favorable but with limitations.
	Grey-black soils.	Neutral to slightly acid.	Favorable.
	Halomorphic (periodically humid saline soils).	Alkaline.	Unfavorable (re salinity).
	Rendzina (or high lime soils).	Alkaline.	Unfavorable (due to excessive lime carbonate).
	Locally humid (non saline soils)—		
	Meadow-prairie soils.	Neutral to slightly acid.	Moderately favorable for certain species.
	Meadow soils.	Neutral to slightly acid.	Moderately favorable for willow, etc.
	Swamp podzols.	Acid.	Unfavorable (too wet).
Forest (Boreal).	*Zonal soils.*		
	Grey wooded.	Neutral to slightly acid.	Favorable.
	Associated soils—		
	Rendzina (or high lime) soils.	More or less alkaline.	Limited adaptation.
	Sandy podzols.	Acid.	Favorable.
	Locally humid associates—		
	Meadow soils.	Neutral (acid to alkaline).	Limited adaptation (willow, tamarack).
	Swamp podzol soils.	Acid.	Unfavorable (re wet conditions).
	Peats (organic soils).	Variable (acid to alkaline).	Limited adaptation (black spruce and tamarack if not high lime).

*In addition, local sites and locally more humid conditions, such as may occur in immature soils, or recent deposits on river terraces and flood plains, or in deep ravines, can be, and are, found in any of the soil zones listed. On such sites native trees and shrubs may be present, even though they are normally absent on the zonal and intrazonal soils of the region.

of such juvenile tree vegetation that may have been introduced by natural seeding in abnormally moist periods.

(*b*) *Local soil drought:*

Local soil drought may develop or be aggravated by such adverse soil conditions as gravelly and coarse textured deposits; by knoll positions and topographical forms from which there is excessive run-off; by the dry exposures of southern and western slopes; and by the shallowness, or absence of soils over rock outcrop.

(*c*) *Adverse soil reaction:*

Highly alkaline soil reaction is unfavorable for tree growth. (See Table No. 3.) Many species of trees planted in high-lime soils, or soils with an excess of lime-carbonate, develop lime-induced chlorosis through low availability of iron, as well as other nutritional troubles. High concentrations of the products of weathering in the soil solution cause physiological drought; and saline soils, or soils with an excess of toxic soluble salts, cause toxicity and plasmolysis. Salinity of the soil water and excess lime will inhibit the natural introduction and growth of trees, even though otherwise soil moisture may appear favorable in certain sites.

(2) CONDITIONS THAT ARE UNFAVORABLE FOR THE NATURAL REPRODUCTION OF TREES:

(*a*) *General unfavorable conditions:*

Conditions are unfavorable for the reproduction of trees where there is insufficient moisture in the soil, or where there are wide fluctuations from moisture to drought; where there is too wide a range of soil temperatures brought about by low water retention capacity of coarse textured soils; where there is too little shade, or too much direct sunlight; where there is a low content of humus or the absence of organic matter at the soil surface; where the soil surface is alkaline, high in lime, or saline; where destruction of young seedlings is brought about by grazing stock or fire; and where there is strong competition with other forms of vegetation better adapted to the conditions of the growth site.

(*b*) *Absence of coniferous mother trees:*

The general absence of conifers in the native woods of the grassland region is also significant. In this connection it may be noted that the seeds of broad leaved trees may be readily distributed; they can germinate and grow under conditions that are unfavorable for the germination and establishment of conifers. If conifers cannot become established naturally because of the inhibition of seedlings, it is evident that the mother trees could not be produced to provide for the further propagation of the species. Hence, while broad leaved trees may be considered as the pioneers of boreal forest, the conifers (such as white spruce, which is one of the climax trees in the boreal forest, and jack pine, etc.) have not followed the aspen groves (as might have been expected with the passage of time), because of the general absence of coniferous mother trees in the aspen grove region, and of effective means of natural seed distribution over the intervening grasslands.

TABLE No. 3—OPTIMUM pH* FOR GROWTH OF COMMON SPECIES OF TREES AND SHRUBS

ACCORDING TO COMPILATION BY C. H. SPURWAY**

Conifers:	pH	*Broad Leaved Trees:*	pH	*Bushy Broad Leaved Trees:*	pH	*Shrubs:*	pH
Spruce, black	4.0–5.0	Aspen or trembling poplar	3.8–5.5	Birch, glandular	5.0–6.0	Caragana	6.0–7.0
Pine, jack	4.5–5.0	Mountain ash (Amer.)	4.5–5.5	Saskatoon	5.0–6.0	Red osier dogwood	6.0–7.0
Fir, balsam	5.0–6.0	Oak, bur	5.0–6.0	Cherry, pin	5.0–6.0	Silverberry	6.0–7.0
Spruce, white	5.0–6.0	Birch, white	5.0–6.5	Alder	5.5–6.5	Hazel (American)	6.0–7.0
Pine, red	5.0–6.0	Birch, weeping	5.0–6.5	Hawthorn	6.0–7.5	Lilac, common	6.0–7.5
Tamarack	5.0–6.5	Crab apple	5.0–6.5	Highbush cranberry	6.5–7.5	Ninebark	6.0–7.5
Pine, Scots	5.0–6.5	Ash, green	6.0–7.5	Cherry, choke	6.0–8.0	Willow:	
Pine, Swiss Mtn.	5.5–6.5	Ash, black	6.0–7.5	Plum, Canada	6.0–8.0	(heart-leaved)	6.0–8.0
Cedar, Rocky Mtn. red	5.5–7.0	Basswood	6.0–7.5	Plum, wild	6.0–8.0	(peach-leaved)	6.0–8.0
Cedar, Eastern white	6.0–7.5	Crab apple (Cult.)	6.0–7.5	Willow, laurel	6.0–8.0	(Bebbs)	6.0–8.0
Spruce, Colorado blue	6.0–7.0	Elm, American	6.0–7.5	Willow, acute leaved	6.0–8.0	Hackberry	6.0–8.0
		Mountain ash (European)	6.0–7.5	Willow, Britzensis	6.0–8.0	Buffalo berry	6.0–8.0
		Manitoba maple (Boxelder)	6.0–8.0	Willow, golden	6.0–8.0	Cotoneaster	6.0–8.0
		Cottonwood	6.0–8.0			Mock orange	6.0–8.0
		Poplar, balsam	6.0–8.0			Honeysuckle	6.0–8.0

Significance of pH values—

	4.0 4.5 5.0	5.5	6.0	6.5	7.0	8.0		8.5	9.0
Soil reaction	Very strongly acid.	Strongly acid.	Moderately acid.	Slightly acid.	Neutral.	Weakly alkaline.	Alkaline.	Strongly alkaline.	Very strongly alkaline.

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*Trees will grow over a wider range than listed above, but well developed, healthy, large sized and long lived specimens should not be expected if the soil reaction is well over on the alkaline side of the optimum range.

**"Soil Reaction (pH) Preferences of Plants." C. H. Spurway, Mich. Agric. Expt. Stn. Special Bulletin 306 (1941).

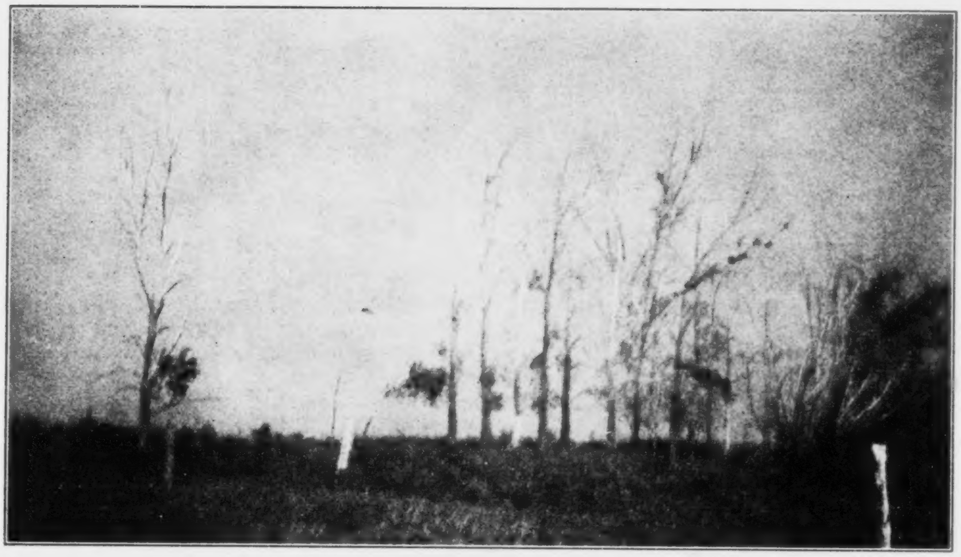

ILLUSTRATION No. 3

Dust storm in southwestern Manitoba, and dead maple trees of a farmstead shelterbelt killed by continuous drought in successive years. These trees were planted on a dark brown-blackearth transition soil developed on boulder till. Water in this soil fluctuates and is dependent upon the fluctuating precipitation; the subsoil and substrata is periodically dry for long intervals.

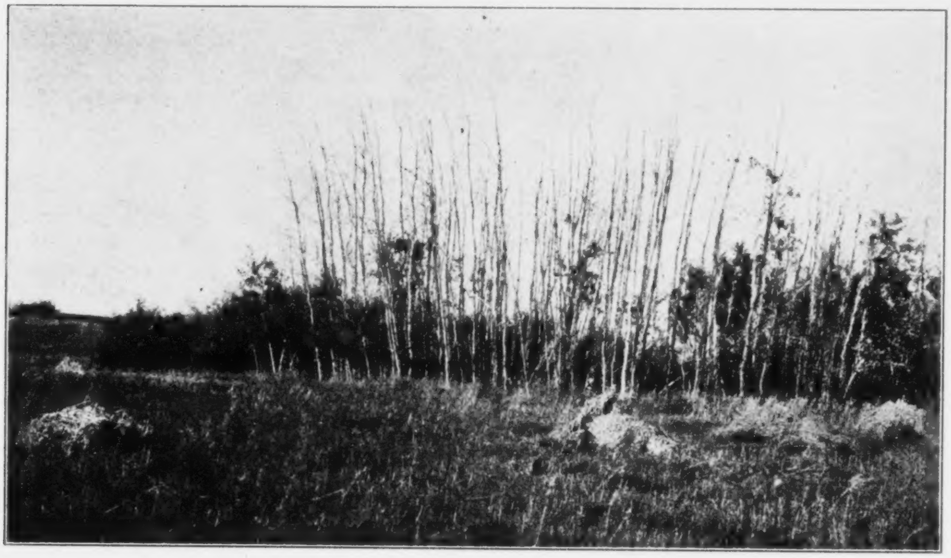

ILLUSTRATION No. 4

Native grove of aspen surrounding a depression in the prairie, southwestern Manitoba, killed by severe periodic drought. The survival of the willows and poplars in the lower portion of the depression shows the contrast of moisture conditions of the respective sites.

ILLUSTRATION No. 5

Part of the Souris channel where soil drought and alkaline reaction inhibit the production of trees.

ILLUSTRATION No. 6

View of dried lake bed (Whitewater Lake) showing strongly saline area that is too alkaline for tree growth. Vegetation shown is largely salt grass (Distichlis stricta), Western sea blite (Suaeda depressa) and gumweed (Grindelia squarosa).

Illustration No. 7

Young aspen grove in a cultivated field on Carroll soil severely injured by fire from the burning of stubble. Such groves should be protected by adequate fire guards and fenced (where needed) to keep out livestock, if they are to be conserved for farm woodlots.

* * *

Young aspen (close-up of No. 7), showing the burnt bark and fire charred base of the trunks. The shrubs also were destroyed. (Photo taken July, 1945.)

Illustration No. 8

ILLUSTRATION No. 9

Limestone rock outcrop with insufficient root room, where the growth of poplar and shrubs is short lived. (Inter-Lake area.)

ILLUSTRATION No. 10

Marked contrast in growth sites on high-lime soils in the southern Inter-Lake area. The grassed portion is lowland peat that is too wet for deciduous trees and too alkaline for tamarack and black spruce. The intermediately drained (organic-mineral) soils are covered with willows. The better drained soils are covered with aspen and balsam poplar. The absence of conifers and the premature death of the poplar on the high-lime mineral soils are apparent.

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III. CONDITIONS WHICH FAVOR THE NATURAL DISTRIBUTION AND DEVELOPMENT OF TREES IN THE PRAIRIE-ASPEN GROVE REGION

In addition to summarizing the unfavorable conditions that have limited or inhibited the general zonal development and reproduction of trees in the grassland region, it is also important to summarize at this point the favorable conditions that co-exist locally where local soil-climate and intrazonal soils have favored the establishment of certain tree species. The more common growth sites under which trees do occur naturally in the grassland region therefore are enumerated in a general way as follows:

A. Sites with locally moist atmospheric climate due to relatively high altitudes which result in lower temperatures and higher moisture effectivity (such as on Turtle Mountain where woods prevail above the 1900 foot contour).

B. Sites with locally humid soils (or soils with more than regionally normal moisture), such as are found:

(1) On the northern and eastern exposures of morainic hills, ravines and river banks,

(2) In ravines and depressions that form snow traps,

(3) On the higher altitudes, on the northern and eastern slopes, and on the bench lands of the Manitoba escarpment,

(4) On the ring-like intermediately drained positions around the depressions on the prairie (if they are non-saline),

(5) In river valleys, on river terraces and on flood plains,

(6) On sandy deposits with moist substrata, or where ground water is commonly found within reach of plant roots, and—

(7) On the transitional areas adjacent to the forest where woods have been able to invade the more humid portions of the tall-grass prairie.

C. Sites with soils that are regionally low in lime, or where the soil mineral parent materials are non-calcareous, such as where soils are developed on shale drift, or where there are outcrops or mounds of weathered cretaceous shale.

In such sites where trees do occur naturally *in the grassland region of Manitoba*, the variety of trees indicates species adaptation. At the same time the absence of other varieties may indicate species limitation. Where woods do occur, aspen and balsam poplar are invariably present; aspen is usually the dominant poplar, but the balsam poplar frequently occurs in larger percentage where the increase in soil humidity is due to ground water. Bur oak occurs in the drier woodland sites, such as at the crest of ravines and river banks, on shale knolls, and along the line where the forest fringes the prairie. Ash is scattered among the poplars on the long slopes of steep ravines; elm, maple (boxelder), cottonwood, and basswood are largely confined to river valleys and flood plains. Paper birch is sparsely scattered on wet sites, in river valleys adjacent to springs, and at the highest altitudes in Turtle and Riding Mountains. Willows are distributed over a variety of sites according to species adaptation.

These broad leaved trees comprise practically all the important native trees found in the province south of the forest region, except in one area, i.e., the upper Assiniboine delta. Here, white spruce occurs in the sand dune portion, and a limited amount of tamarack may be found in the hydromorphic or water saturated sands. Insofar as is known, pines do not occur naturally in any part of the prairie-aspen grove region in Manitoba.

The fundamentals which govern the ecological distribution of trees referred to in the above paragraphs are relatively simple. These fundamentals must be kept in mind as basic principles in planning any future tree culture projects in Manitoba. The native species of trees and their environment (if undisturbed) constitute an excellent guide in selecting other species for introduction to specific sites.

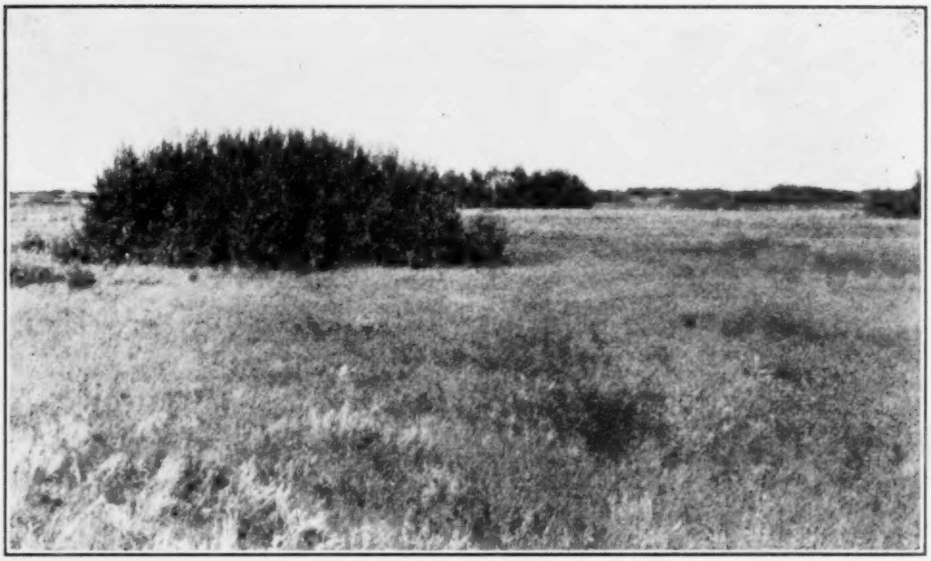

ILLUSTRATION No. 11

Example of natural woodlot types—Clumps of young aspen in the local, periodically moist depressions in the prairie near Pierson are typical of the extreme southern portion of the prairie and aspen grove region.

ILLUSTRATION No. 12

Example of natural woodlot types—Larger groves of immature aspen in local, periodically moist depressions in the prairie near Reston. These groves should be conserved and improved for farm woodlots and wild life use.

Illustration No. 13
Example of natural woodlot types—Typical groves of aspen in the northern blackearth zone near Minnedosa. These groves start naturally in the intermediately drained positions, but they become larger and creep farther up the slopes in the northern portion of this zone. Conifers are not found naturally but, if introduced, would thrive and would give a wider variety of utility trees in these farm woodlots.

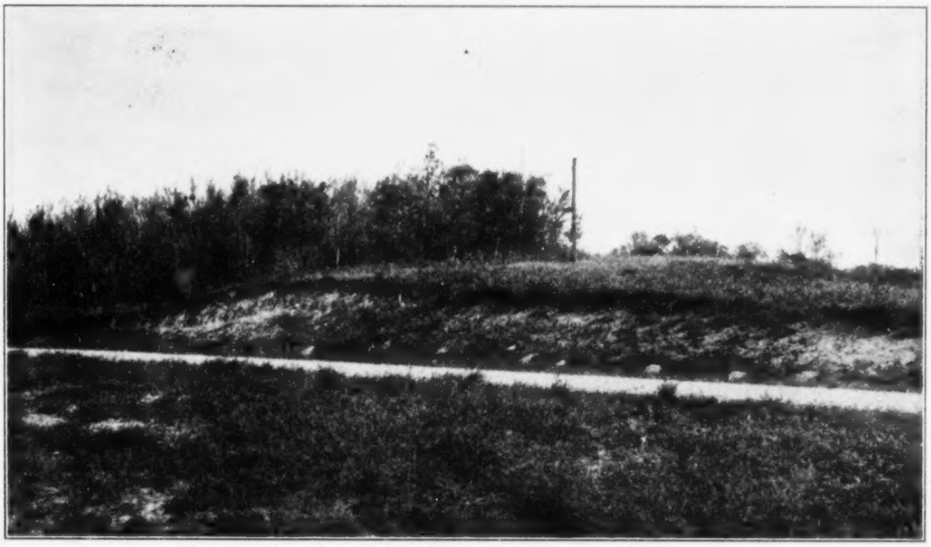

Illustration No. 14
Example of natural woodlot types—A hillside woodlot in the Tiger Hills. Here southern slope and crest are under grass but the northern slope shows zonation of tree species. Oak occupies the upper drier portion of the slope, and willow the lower and more moist sites. Poplar dominates the main portion of the slopes, with a few scattered green ash. These hillside woodlots should be maintained for the production of fuel, fence posts, etc. The introduction of pines on the upper slopes and spruce on the lower slopes would give a greater variety of utility woods and improve the scenic effect.

ILLUSTRATION NO. 15

Examples of natural woodlot types—Hillside woodlots in the Tiger Hills north of Ninette. Soil on northern and eastern slopes under oak and poplar woods. Soil on southern and western slopes under grass.

ILLUSTRATION NO. 16

Example of natural woodlot types—Close up of zone of stress between woods and prairie in the Tiger Hills. Photo taken at the crest of a hill looking northeastward, showing oak occurring on the driest wooded site.

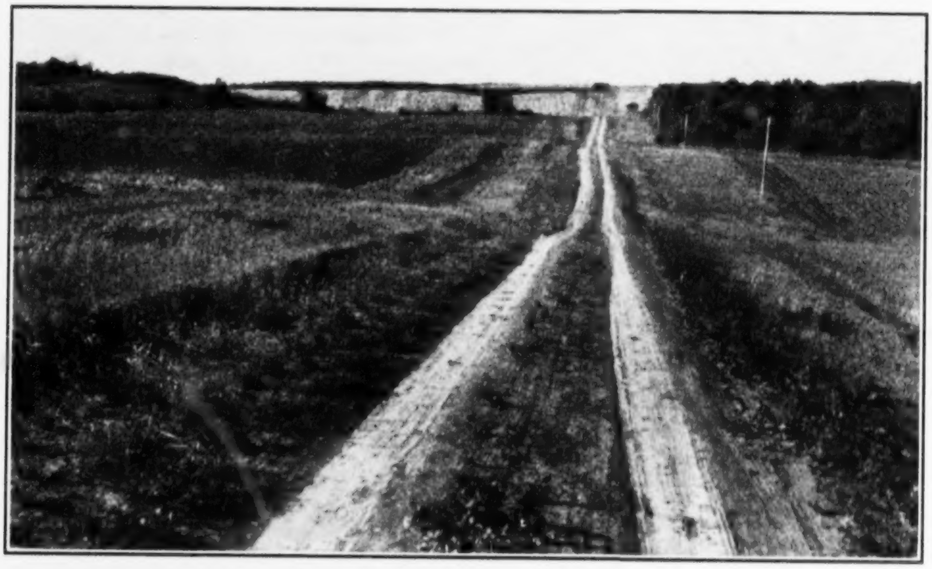

ILLUSTRATION NO. 17

Example of natural woodlot types—Scene in the Pembina Hills soil association originally covered with poplar, oak, ash and elm woods. On the rolling lands of this association clearing has been extensive, but uncleared areas remain which can be maintained and improved as farm woodlots. Natural hedges are seen in the fence lines; these should have been left on contours instead of along the margin of square fields.

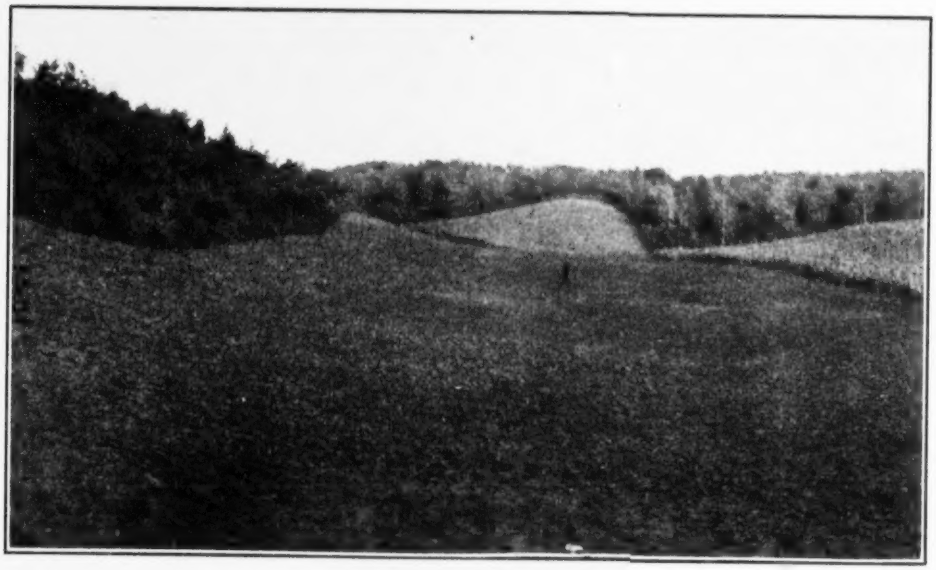

ILLUSTRATION NO. 18

Example of natural woodlot types—Wooded slopes of the Manitoba escarpment (Assiniboine section). The incongruity of attempting a square layout on a round topography is here well illustrated. To control soil erosion, and for ease of operation, clearing and breaking on such sites should be done in strips which follow the contours. Woods on the more abrupt slopes should be retained as woodlots.

ILLUSTRATION No. 19

Example of natural woodlot types—Single specimens and scattered clumps of white spruce interspersed with sparse grass, artemisia, cacti, and ground juniper, occurring in the sand dune area of the Assiniboine delta. This is a good site for the growth of conifers, but the difficulties and slow rate of natural reproduction necessitate an afforestation program if idealized land utilization is to be achieved.

ILLUSTRATION No. 20

Example of natural woodlot types—Oak growing on a shale mound in south-central Manitoba. The thin stand here shown is the result of cutting. Conservation and re-establishment of the native species and the introduction of new species such as pines are needed to insure maximum utilization on growth sites of this type

ILLUSTRATION No. 21

Example of natural woodlot types—Woodland invasion of prairie was general on good soils in the Altamont district prior to settlement and was responsible for the extensive local development of excellent native woods. Although most of the area has been put under arable culture, natural woods still remain that could be developed as ideal farm woodlots.

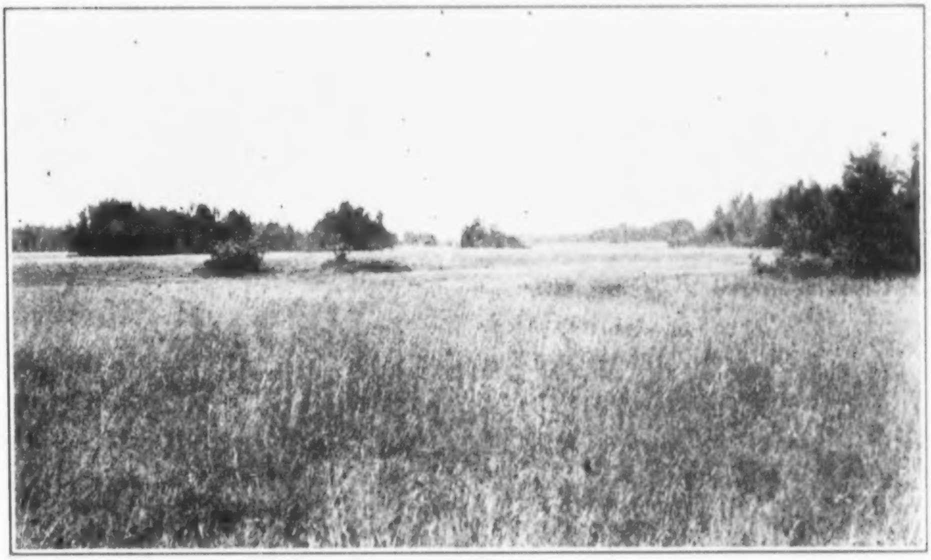

ILLUSTRATION No. 22

Example of natural woodlot types—Groves of immature aspen and balsam poplar on high-lime soils, with low ridge and swale topography in the southern portion of the Inter-Lake area. These high-lime soils are problem sites which should be thoroughly investigated before a long time tree development program is attempted.

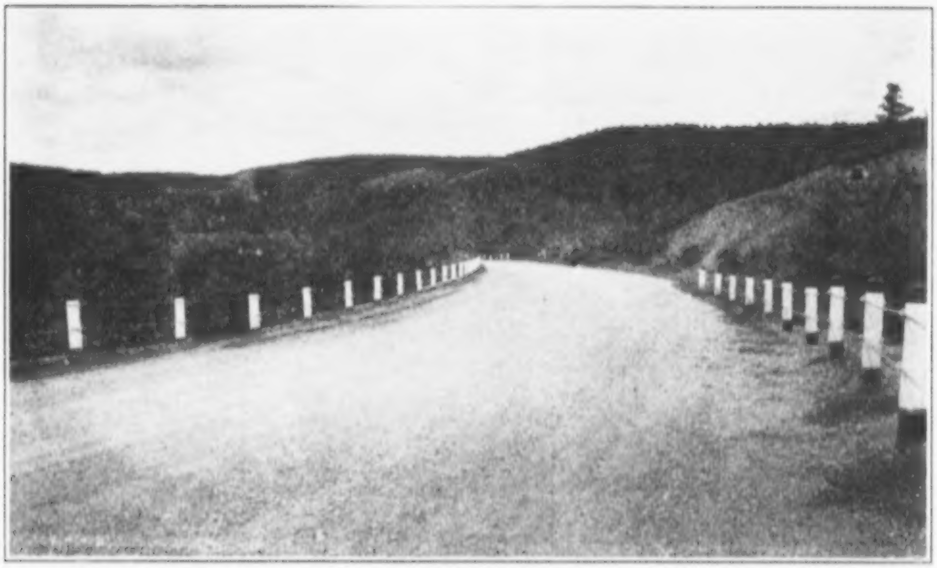

ILLUSTRATION No. 23

Example of natural woodlot types—Wooded slopes of deep ravines and river channels cut into the underlying shale, naturally covered with oak, poplar, ash and birch, have both woodlot and scenic values which could be improved by conservation and by the introduction of coniferous species. Exploitation is here shown by over-cutting of the woods for fuel and fence posts.

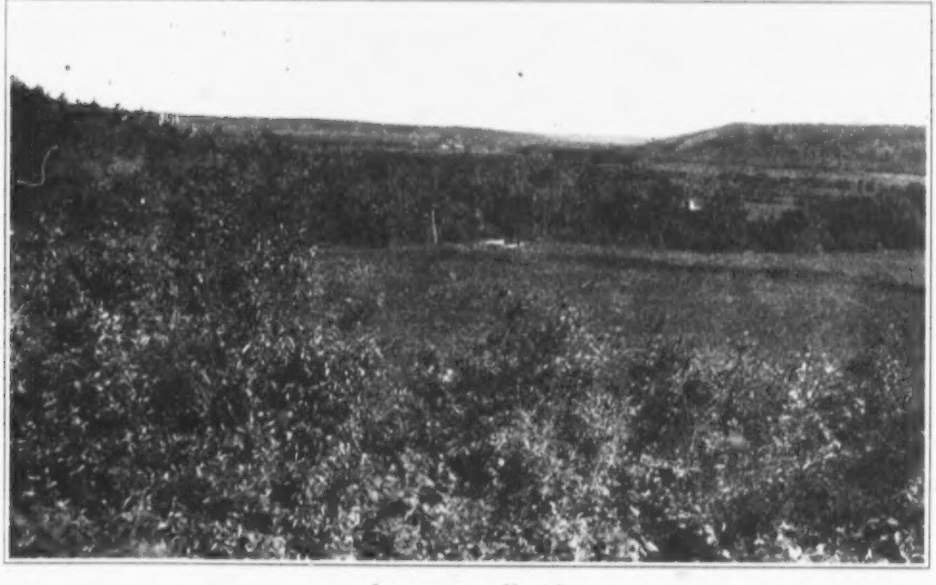

ILLUSTRATION No. 24

Example of natural woodlot types—Wooded slopes and valleys in the Pembina channel where zonation of tree species on the different growth sites is well marked. The introduction of pines on the upper slopes and of spruce on the lower slopes and in the valley; together with the conservation of the native oak, ash, and birch of the slopes, and elm, oak, maple, poplar, etc., of the flood plains and river terraces could improve the woodlot value of these deep river channels.

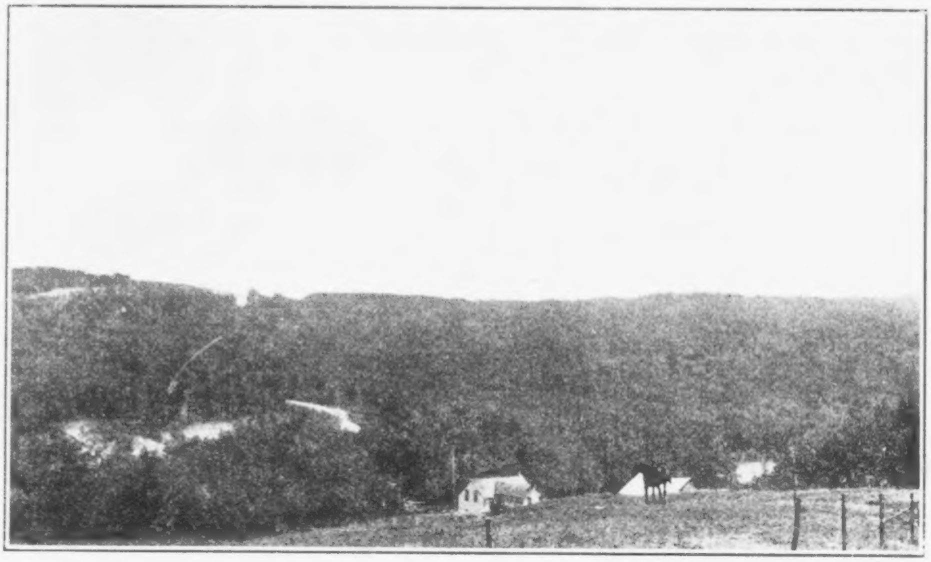

ILLUSTRATION No. 25

Example of natural woodlot types—Naturally wooded slopes of the deep river valleys west of the escarpment. Could be developed and maintained as private, community, or municipal woodlots.

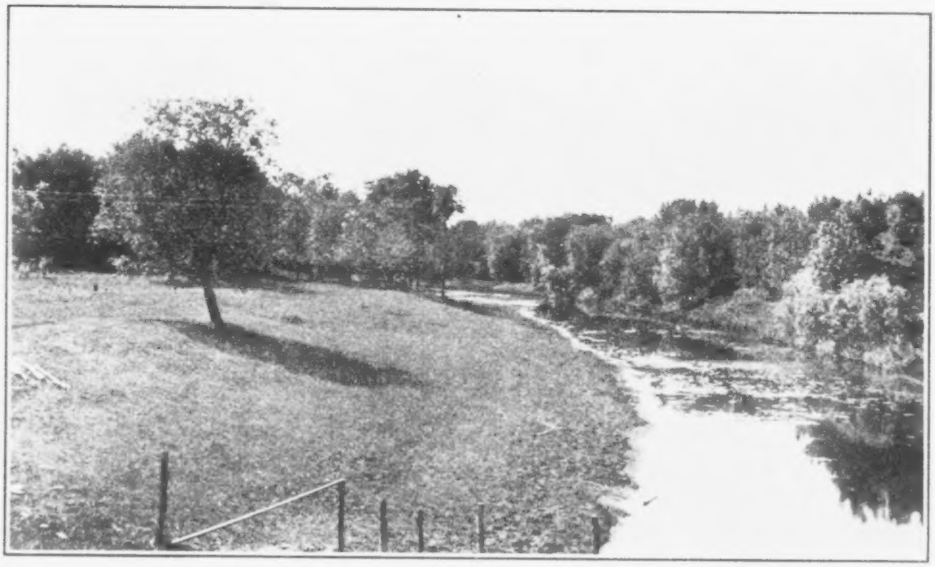

ILLUSTRATION No. 26

Example of natural woodlot types—The immature soils of terrace and flood plains provide ideal growth sites for the native elm, Manitoba maple, basswood, cottonwood, etc., which invariably fringe the rivers and streams in the blackearth region.

IV. CONDITIONS, CHARACTERISTICS AND PROBLEMS, FROM A FARM FORESTRY STANDPOINT IN MANITOBA, BY REGIONS, SOIL ZONES, LANDSCAPE AREAS AND SOILS; AND THE TREE CULTURE PROJECTS RECOMMENDED

Although the fundamental principles affecting the natural distribution of trees that are dealt with in the previous section are relatively simple, the various patterns of favorability and unfavorability for tree growth actually met with in Manitoba are varied and complex. Hence, programs of tree culture suitable for the variety of conditions that exist must be considered in relationship to the conditions, characteristics, problems and needs in the respective unit areas. The local unit areas and the tree culture projects recommended for each are outlined in the following section. The geographic distribution of the unit areas is shown in the sketch map presented in Figure No. 4. The letter symbols on the sketch map correspond to those used in the following explanatory outline.

(1) Grassland Region, Southwestern Manitoba

Dark Brown-Blackearth Zone (D)

D_1 SOILS DEVELOPED ON BOULDER TILL—WASKADA SOIL ASSOCIATION.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

Waskada soils in the normal position are usually clay loam to heavy loam in texture, and neutral to alkaline in reaction. They have good water retention capacity and are naturally fertile, but soil moisture is often deficient due to severe atmospheric drought. Water in the soil is dependent solely on precipitation, which may be inadequate to support trees in some seasons. The soils on the knolls and slopes, and especially those with southern and western exposures, frequently are excessively dry. The associated soils in the depressions, or in the intermediate and low positions that have somewhat more favorable moisture conditions, generally contain either varying amounts of soluble salts (alkali) or an excess of lime carbonate. Thus limitation of moisture, and alkaline soil reaction, are problems that restrict extensive tree culture in this area.

Tree Culture Projects Recommended

1. Farmstead shelterbelts of relatively drought resistant trees on the more favorable sites, and grown under management practices planned to meet the comparatively difficult regional conditions.
2. Tree or shrub planting around dugouts and gardens, to trap snow and provide wind protection, and to reduce evaporation from surface stored waters. (Dams and dugouts.)
3. Planting of relatively drought tolerant shade trees, specimen trees and shrubs in towns and villages.

D_2 SOILS DEVELOPED ON LACUSTRINE SEDIMENTS—WHITEWATER SOIL ASSOCIATION.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Whitewater soils are dominantly of clay to medium heavy texture. They occupy a flat topographical position and have slow internal drainage. They are alkaline in reaction and in some locations are strongly salinized.

Tree Culture Projects Recommended

Not suitable for trees, except where there may be less alkalinity in limited local sites.

D_3 SOILS DEVELOPED ON GRAVELLY DEPOSITS—CARTWRIGHT-BEDE SOIL COMPLEX.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

This soil complex consists of a mixture of Cartwright and Bede soils developed on gravelly outwash and coarse textured waterworked materials. The Bede soils have excessive internal drainage and may be considered too dry for tree culture. The Cartwright soils are the poorly drained members. They have more favorable moisture conditions due to the periodic presence of ground water. However, they are sometimes salinized and usually have an excess of lime carbonate. The alkaline condition limits or inhibits extensive tree culture.

Tree Culture Projects Recommended

Satisfactory tree growth cannot be expected except in the limited areas that are relatively free from alkalinity. The inferior soils here are better suited to grazing.

(2) Prairie and Aspen Grove Region

Consisting of:

Blackearth Soil Zone	B
Northern Blackearth Soil Zone	N
Dark Colored High-lime Soil Zone	H
Forest Islands and Islands of Woodland Invasion in the Grey-Black and Grey Wooded Soil Sub Zones	G
Wooded Valleys of Rivers and Streams	W

Blackearth Soil Zone (B)

B_1 SOILS DEVELOPED ON BOULDER TILL.

Including:
(a) Oxbow Soil Association,
(b) Hilton-Tiger Hills Soil Complex,
(c) Darlingford-Manitou Combination.

(*a*) *Oxbow Soil Association*:

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Oxbow soils, in the normal position, are of good texture (loam to clay loam), with a fairly good retention capacity for water. The amount of water present is often low due to limited precipitation. The moderately high-lime condition of the soil tends to aggravate the drought conditions that sometimes occur.

The terrain is a till plain with numerous low hillocks and shallow undrained basins or depressions. The associated soils which occupy the knolls or hillocks and the dry uplands resemble the Waskada soils. These locally arid soils are more droughty than the soils in the normal positions and are unsatisfactory for the growth of trees. The numerous undrained shallow basins are either tree ringed swales or alkalinized sloughs. Aspen poplar and willow occupy the moist intermediate positions where the soils are not salinized and give the area a park-like aspect. Provided the location is not salinized, trees can be grown in the soils of the intermediate and normal positions in a system of contour planting similar to the concentric ringed pattern indicated by the natural islands of aspen and willow.

Tree Culture Projects Recommended

1. Farmstead shelterbelts of relatively drought resistant trees on the more favorable sites, and grown under management practices planned to meet the difficult regional conditions.
2. Tree or shrub planting around dugouts and gardens, to trap snow and provide wind protection, and to reduce evaporation from surface stored waters. (Re dams and dugouts.)
3. Planting of selected species of shade trees, specimen trees and shrubs in towns and villages.
4. Preservation of the native tree vegetation around the depressions for woodlot production and improvement of the natural woodlots by introduction of utility woods.
5. Preservation of the park-like condition for the protection of game birds.

(b) *Hilton and Tiger Hills Soil Complex:*

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Hilton and Tiger Hills soils are developed on high-lime or calcareous boulder till deposits with varying topography.

Where the topography is slightly undulating with low hillocks, and on the southern and western slopes where the topography is hilly, the original vegetation was grassland prairie. Here, under the grassland vegetation and the prevailing climate, shallow and somewhat calcareous blackearth soils developed which have been designated as Hilton clay loam to loam. The calcareous Hilton soils are not favorable for general tree culture. The poorer and stonier phases of Hilton soils are more suited to grazing than to tree culture. The locally moist soil associates of the Hilton soil association are invariably salinized, and hence there is a general absence of native tree growth on such sites.

Where the topography is hilly or morainic the northern and eastern exposures of the stronger and rougher slopes are more humid and consequently less calcareous. These sites are more or less covered with native growths of oak, poplar and willow, and a limited scattering of green ash. Here, under tree vegetation and a somewhat more humid climate, grey-black soils have developed which have been designated as Tiger Hills clay loam to loam. In the Hilton-Tiger Hills soil complex, the native treed areas are found almost exclusively where the high-lime condition of the soils has been reduced by the greater downward movement of water in the soil due to (a) lower temperatures of the northern and eastern exposures; (b) to the local trapping of snow; and (c) to the higher local moisture efficiency.

The Tiger Hills soils are favorable for the production of a number of tree species, but there are serious problems in the production of trees on the Hilton soils, such as alkaline reaction, salinity and physiological drought.

Tree Culture Projects Recommended

The projects listed as 1, 2 and 3 for Waskada soils are recommended for the Hilton soils

1. Farmstead shelterbelts of relatively drought resistant trees on the more favorable sites, and grown under management practices planned to meet the difficult regional conditions.
2. Tree or shrub planting around dugouts and gardens, to trap snow and provide wind protection, and to reduce evaporation from surface stored waters. (Re dams and dugouts.)
3. Planting of selected species of shade trees, specimen trees and shrubs in towns and villages.
4. The native woods on the unbroken and stony phase of the Tiger Hills soils can be maintained as woodlots. They should be further developed for the introduction of other tree species and put under a system of regulated cutting and improved management.

(c) *Darlingford-Manitou Combination:*

This soil combination includes the Darlingford, the Manitou and the Snowflake Soil Associations.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Darlingford and Manitou soils are good blackearth types developed under tall prairie grass vegetation interspersed with groves of aspen. In addition a few shale mounds occur as outcrops on which there are good stands of oak. Hence, the climate favors the production of trees in this area.

The normal Darlingford soils are moderately deep blackearths developed on mixed boulder till with undulating topography. The soils of this association in general can be used for tree production if required, but it is important that suitable species be selected for planting in the different topographical positions.

The Manitou soils are deep blackearths developed on shale drift with smoothly undulating to gently rolling topography. These soils have a low lime content due to the mineralogical composition of the soil parent material. They are neutral to slightly acid in reaction, and trees can be grown successfully on the Manitou soils, whether they occupy the knolls, slopes or the normal positions. The only exceptions are the hydromorphic depressions which are usually occupied by sloughs. The Manitou soils are clay loam to clay in texture, and are derived from shale. They are dusty when dry, and very susceptible to wind erosion. They grade into weathered shale at from three to six or more feet. Hence, it is especially important that these soils be protected from wind erosion; trees can be used advantageously for this purpose.

The Snowflake soils are blackearths and alkaline soils developed on a mixture of Darlingford and Manitou parent materials. Owing to somewhat flat topography and poor internal drainage, these soils usually are more or less salinized, especially in and around the shallow micro relief depressions. Hence, the Snowflake soils are not so favorable for tree production as the Manitou and Darlingford soils.

Tree Culture Projects Recommended

1. Renovation and maintenance of established farmstead shelterbelts throughout the area.
2. Combined farmstead shelterbelts and farm woodlots on Darlingford and Manitou soils.
3. General renovation of town and village plantings.
4. Field shelterbelts for soil protection on the Manitou Association.
5. Maintenance and control of woodlots on the mounds of shale outcrop.

B_2 SOILS DEVELOPED ON GRAVELLY OR COARSE TEXTURED DEPOSITS.

These include the Bede, the Marringhurst and the Agassiz Soil Associations.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Bede and Marringhurst soils are developed on outwash gravel and coarse sand. The surface soils are droughty, but in some cases the gravelly substrata may contain ground water. Where ground water is present in the substrata there may be some possibility for woodlot development if the right type of trees were planted in moist periods. The normal soils, however, may be considered as generally too droughty for tree culture. The Agassiz soils are developed on gravel and sand beach ridges. They have a low water retention capacity; in the southern portion of the aspen grove region they are invariably too droughty for successful tree culture.

Tree Culture Projects Recommended

The possibility of tree culture on the better phase gravelly soils, where ground water is present, should be investigated; comparisons should be made between wood production and grass production to ascertain which is the best form of land use.

B_3 SOILS DEVELOPED ON SANDY OR LIGHT TEXTURED DEPOSITS.

These include:

(a) Sandy textured soils of the Souris basin—Souris sands.

(b) Sandy textured soils of the upper Assiniboine delta—Stockton sands and dunes.

(c) Sandy textured soils of the lower Assiniboine delta—Almasippi light sandy loams.

(d) Sandy textured soils of the Red River Plain—Altona sandy loam, light phase.

(a) *Sandy textured soils of the Souris Basin*

Conditions, Characteristics and Problems from a Tree Culture Standpoint

Soils developed on light textured deposits of the Souris basin range in texture from sands to loamy sands (interspersed with low sand dunes), to sandy loams and fine loams. These varied textured deposits are under varied moisture conditions and include a number of different soil types. From a tree culture standpoint they may be grouped into three categories:

(1) Soils suitable for arable culture, which include the Souris fine loams and Souris sandy loams. These soils are arable and have a moist substrata. They have a flat topography and are very susceptible to soil drifting. As an aid in the control of soil drifting, field shelterbelts should be extensively developed.

(2) Hydromorphic or wet sands under a natural cover of wet land grasses and sedges which are found extensively in the lower portion of the Souris basin. These wet sandy soils are naturally better suited for the production of grasses (hay and grazing) than for tree culture.

(3) Sand dunes.

Tree Culture Projects Recommended

1. Field windbreaks to aid in soil conservation and soil drifting control on the arable fields throughout the Souris basin.
2. Woodlot development or afforestation on the duned areas and the interspersed sandy soils with moist substrata.
3. Experimental plantings to determine the adaptation of tree species on the different sites that are present. A suitable long-time woodlot policy then could be based on the results of these experiments.
4. Renovation of farmstead shelterbelts.
5. Renovation of plantings in towns and villages.

(b) *Sandy textured soils of the upper Assiniboine Delta*

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The light textured soils of the upper Assiniboine delta include sand dunes and Stockton sands. The native vegetation on the dunes is sparse bunch type grasses, ground juniper, scattered spruce and scrub oak. Between the dunes and in the relatively more moist sites an inferior growth of aspen and willow occurs. Portions of the duned areas are included in the Spruce Woods Forest Reserve. The Forest Service has demonstrated the adaptability of jack, Scots and lodgepole pine, along with white spruce, for afforestation and woodlot purposes in this area. The duned portion outside the reserve could be developed as woodlot areas, but some form of afforestation planting is required due to the insufficiency of mother trees, and to the difficulty of propagation by natural seeding in the warm dry sand of the untreed portions.

The Stockton soils are loamy sands or light textured soils interspersed between and around the duned areas.

The Stockton soils are of fairly smooth topography and are developed under prairie and aspen grove vegetation. Ground water usually occurs at a depth of about 20 feet in the well drained positions. In the depressed areas ground water is found nearer to the surface and the surface is covered with aspen, pin cherry, choke cherry and willow.

The Stockton soils can be used for woodlot purposes, and because of their extreme susceptibility to soil drifting, all fields used for arable culture should be protected by field shelterbelts, by trash cover or by periodic seeding down to grasses and legumes.

Tree Culture Projects Recommended

1. Extensive afforestation for woodlot development is recommended, especially for the duned portions.
2. Preservation and conservation of native tree growth.
3. Judicious use of native tree growth, supplemented by planted shelterbelts for soil protection, is essential where the topography is smooth and where arable culture is practised.
4. The possibilities of tree fruit culture on the better local soils should be investigated.
5. Extension of the present Spruce Woods Reserve or the establishment of municipal woodlots.
6. Extension of the present afforestation program already initiated within the forest reserve.

(*c*) *Sandy textured soils of the lower Assiniboine Delta*

These include the Almasippi light sandy loams.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Almasippi loamy sands and light sandy loams are dominant over this area. These light textured soils have moist subsoils. The native vegetation is tall prairie and meadow grasses interspersed with large islands of vigorous aspen poplar, balsam poplar and willows. The area covered by poplar and willow is extensive and the vigor of the trees indicates good growth site conditions. This is due to the moist subsoils. The arable fields of the Almasippi soil association are suitable for grasses, legumes and feed crops for the maintenance of livestock. However, protection from soil drifting is essential because the surface soils are very susceptible to drifting when exposed. Wholesale clearing of native woods should be avoided and the cutting of trees should be regulated. Strips of native trees should be retained for field protection and these should be supplemented by planting of field shelterbelts. The shelterbelts thus produced could be utilized as farm woodlots and made to contribute to the general farm income.

Tree Culture Projects Recommended

1. Conservation of the native woods.
2. Field shelterbelt planting supplementary to the native woods for the protection of the cultivated soils from drifting.
3. The introduction of other tree species and the improvement and management of the native woods, and planted areas as farm woodlots, especially on the non-calcareous imperfectly drained soil associates.

(*d*) *Sandy soils of the Red River Plain*

These include the Altona Soils. (Light Phase.)

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Altona soils of medium and light texture that occur in the southern portion of the Agassiz basin (or the Red River Plain), are light textured blackearths that are very susceptible to drifting. The original vegetation was prairie grasses and herbs. The surface soils and the subsoils are usually well drained, but the substrata is generally moist. Planted trees, such as cottonwoods, and cultivated or exotic willows, etc., have been used extensively in the Mennonite villages, and these indicate good growth sites for trees. These soils, moreover, are susceptible to soil drifting and require surface protection. Nearly all the Altona soils are arable, but there are a few limited areas with imperfect drainage where trees will not thrive due to the local saline or moist alkalinized conditions.

Tree Culture Projects Recommended

1. Extensive field shelterbelt program for soil protection.
2. Provision for the maintenance of farmstead shelterbelts and village plantings.

B_4 SOILS DEVELOPED ON MEDIUM TO FINE TEXTURED LACUSTRINE SEDIMENTS.

These include:

Carroll Soils,
Glenboro Soils,
Holland Soils,
Altona Soils,
Wellwood Soils,
Emerson Soils,
Portage Soils,
Altona Soils (better phase).

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The normal soils of the associations here listed are deep blackearths of good texture (fine loam, very fine sandy loam, silt loam, and fine sandy clay loam). These soils were originally developed under tall prairie grasses and a wealth of associated herbs. The Holland and Wellwood soils were subjected to a certain amount of woodland invasion prior to settlement. In each case, the respective soil associations are fairly uniform in texture throughout, with the exception of the Glenboro association, which grades into a sandy substrata and has ground water at 12 to 20 feet.

The normal soils of this group are almost invariably well drained. They are good to excellent for agricultural purposes and here woodlots are not a recommended form of economical land use. Nevertheless, the soils are well adapted to tree culture for wind protection and shelterbelt purposes. These soils are all subject to a certain amount of soil drifting unless given protection, and injury from soil drifting can be expected to increase with time unless provision is made for its control.

Tree Culture Projects Recommended

1. Extensive use of farm shelterbelts as an aid in soil conservation.
2. Improvement and renovation of farmstead shelterbelts.
3. Renovation, improvement and extension of town and village plantings.

B_5 SOILS DEVELOPED ON HEAVY TEXTURED DEPOSITS.

These include the Red River; the Gretna; the Red River-Emerson Transition; the Burnside; the Myrtle; the Morden; the Westbourne; and the Fort Garry Soil Associations.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The soils here grouped are developed on coarse to heavy textured deposits. The well drained members are clay textured blackearth soils that are utilized for arable culture. The topography in general is flat with only micro relief. In the slight depressions and flat positions meadow-prairie, meadow, calcareous, salinized, and alkalinized soil associates occur. Over much of the surface an extensive system of open ditches has been installed for drainage, and the filling-in of such ditches by soil drifting is becoming more and more of a problem.

Although developed under tall grassland vegetation the well drained soil members of this group are generally well adapted to the growing of trees. Their best use, however, is the production of crops. The intermediately drained and poorly drained soil members, especially those that are calcareous and salinized, present problems in tree culture. Periodic excessive amounts of water, and salinity or alkalinity may inhibit tree culture in local hydromorphic areas.

The Westbourne soils tend to be imperfectly drained and are more or less salinized. The Fort Garry soils have calcareous subsoils. These soils (which are calcareous or high lime) are limited to the production of tree species of lime tolerant type and tree growth may be restricted due to lime induced chlorosis. Thus, the Westbourne and the Fort Garry soils have more limitations or are less favorable for tree culture than the other heavy soils in this grouping.

Tree Culture Projects Recommended

1. Extension and development of farmstead shelterbelts.
2. Development of tree planting in towns and villages.
3. The use of hedges for the protection of drainage ditches and earthworks from soil drifting.
4. Combination of tree and shrub planting for landscape effect in conjunction with hedge planting for road protection from snow drift.

B_6 SOILS DEVELOPED ON MIXED TEXTURED ERODED AND WATERWORKED DEPOSITS.

These include:

Heaslip; Greenway; Blumenstein; Hecla; and Rea Soil Associations, etc.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

Conditions in the soils of this group are variable and complex. Sandy phase, shallow phase, imperfectly drained and alkalinized soils are interspersed with better types in a more or less complex pattern. Hence the suitability for tree culture varies widely.

Tree Culture Projects Recommended

Sites for tree culture here require careful selection. In some cases alkalinity would prevent successful tree culture.

Northern Blackearth Soil Zone (N)

N_1 SOILS DEVELOPED ON BOULDER TILL—NEWDALE SOIL ASSOCIATION.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The well drained Newdale soils are northern blackearths developed under tall prairie grasses on boulder till. The undulating to rolling topography of the till sheet is responsible for considerable variation within the area. A considerable percentage is either depressed or elevated above the normal soils. The depressions which form closed basins are occupied by alkali sloughs and hay swales. Above and surrounding these wetter sites are growths of poplar and willow which increase progressively in size, in area occupied, and in vigor of growth from south to north. The native vegetation in general ranges from prairie and aspen grove in the southern portion (where prairie predominates), through increasing amounts of woodland, until the forested area of Riding Mountain is reached. Trees can be grown generally if desired, except in the wetter salinized depressions or draws, and on the drier knolls and southern slopes.

Tree Culture Projects Recommended

1. Conservation of present wooded sites and improvement of woodlots by the introduction of new species and by the adoption of better management practices.
2. Improvement of farmstead shelterbelts.
3. Improvement of plantings in towns and villages.

Dark Colored High-Lime Soil Zone (H)

H. SOILS DEVELOPED ON MODIFIED DRIFT AND LAKE-WASHED TILL.

Including:

(a) High-lime soils east of the Red River Valley from Lydiatt through La Broquerie to Ridgeville and Caliento.

(b) High-lime soils of the southwestern portion of the Interlake area, and

(c) High-lime soils of the Westlake area south of Alonza and Lake Dauphin.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

This combination of soils occupies a zone of stress between the aspen grove and the forest regions. In these areas the atmospheric climate favors tree vegetation and the native vegetation probably would have been of the forest type were it not for the high-lime nature of the soil parent materials. Due to the conditions which exist, the native vegetation is prairie and meadow grasses and aspen grove. This gives the area a park-like appearance, but of a different type to that occurring in the northern blackearth zone. The soil conditions locally are quite variable owing to: (a) the sorting of the parent materials by water; (b) the presence of limestone rock at or close to the surface; (c) the extensive local areas with impeded drainage, and (d) the local ridges of gravel and sand formed as beach ridges in glacial Lake Agassiz.

The soils in the low position are generally high-lime fen peats that produce swale grasses and sedges. On the better drained sites, native tree growths are fairly common, but the growth is not usually vigorous. The most common trees are aspen and balsam poplar, with willow and hazel shrubs. Oak may be found along with aspen in the better drained areas, but it is found more plentifully on the gravelly beach deposits where the site conditions are drier. Sparse, scrubby and unthrifty growths of oak, poplar, juniper and shrubby potentilla frequently mark the outcropping of limestone rock. Between the wooded areas there are shrubby growths of hazel, swamp birch and willow, as well as large open areas of prairie and meadow grasses.

Many of the soils in these high lime areas are stony or contain cobbles and stony shingle, at or near to the surface.

Although atmospheric climate favors tree growth, the general alkaline reaction of the calcareous or high-lime soils causes lime induced chlorosis and unthrifty tree growth. In addition, such local soil conditions as rock outcrop, shallow depth of soil, poor drainage, and coarse textured deposits locally limit or inhibit tree development.

Tree Culture Projects Recommended

These high-lime soils are not well suited to extensive tree culture, and the acreage of arable land is limited to the less stony and the better drained soils developed on the deeper deposits. The soils under grass in the lower and in the stony areas would be best used under a system of controlled hay and pasture or grazing management.

1. Farmstead shelterbelts should be developed and maintained by the use of native woods supplemented by judicious planting of lime-tolerant trees.
2. The naturally wooded stony areas could be used under a system of protection and control for the production of wood, but forest management methods for this area require study and investigation.
3. Experiments should be undertaken with trees that have higher tolerance for the alkaline soil conditions that prevail.

Forested Islands and Islands of Woodland Invasion (G)

G_1 PEMBINA HILLS AREA.

Including:

(a) Soils developed on Boulder Till—Pembina Hills Soils.

(b) Soils developed on Water Laid Sediments—Altamont soils (medium heavy), Indian Springs soils (sandy).

(*a*) *Soils Developed on Boulder Till—Pembina Hills Soil Association.*

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Pembina Hills soils are a mixture of grey-black and grey wooded soils of clay loam texture and neutral to slightly acid reaction, developed on boulder till with strongly undulating to hilly (morainic) topography. These soils were naturally wooded and covered with poplar, oak and ash, with an undergrowth of hazel and cherry in the well drained sites, and with poplar and willow on the lower slopes. Under virgin conditions these trees thrive and reproduce naturally. The indications are that forest growth first started on the northern and eastern slopes of the escarpment and finally moved westward and southward as a woodland invasion, until the area was more or less completely covered. Under virgin conditions the tree species were chiefly poplars, and oak, with lesser amounts of ash, birch, Manitoba maple, basswood and elm. Spruce and other conifers thrive where they have been planted; no doubt the absence here of conifers in the native woods is due to the absence of mother trees for seed production.

Tree Culture Projects Recommended

The unbroken lands here form natural woodlots. The tree culture projects required are:

1. Conservation of the natural woodlots and the adoption of good forest management practices.
2. Farmstead shelterbelts here involve the use of native woods supplemented by appropriate plantings of other species of utility woods.
3. Improvement and extension of ornamental tree plantings in towns and villages.
4. In clearing and breaking new land excessive clearing should be avoided. Strips of native woods should be preserved to provide a fringe of trees around the cleared fields, or to serve as contour strips for soil erosion control.
5. Trees should be planted on hilly sites to provide contour strips where clearing has been excessive. They should also be planted in blocks on the steeper slopes for the purpose of soil conservation.

(*b*) *Soils Developed on Water Laid Deposits*

Including: Altamont Soil Association,
Indian Springs Soil Association.

Conditions, Characteristics and Problems of the Altamont Soil Association from a Tree Culture Standpoint

These soils are black to grey-black soils developed on medium heavy textured lacustrine sediments. Originally the well drained members were developed under moist grassland vegetation, but later they underwent a woodland invasion by poplar and associated shrubs. The well drained Altamont soils are excellent agricultural lands, so that the woods have been largely removed. Owing to the smooth, gently rolling topography, the low positions are occupied by fairly large sloughs which are unsuited for tree culture. A few isolated mounds of shale occur as outcrops above the general level of the terrain. These mounds are more or less covered with oak trees which are growing in the weathered shale.

Tree Culture Projects Recommended

1. Preservation of the islands of oak for woodlots.
2. Preservation and maintenance of farmstead shelterbelts.

Conditions, Characteristics and Problems of the Indian Springs Soil Association from a Tree Culture Standpoint

The Indian Springs soils are a variable complex of moderately deep grey-black soils, developed under grass, with subsequent woodland invasion, on sandy and mixed textured deposits intermixed with gravelly and gritty textured reworked boulder till. These light textured soils are susceptible to soil drifting when cleared. The coarser textured and gritty portions should be developed for woodlot purposes, but the better textured portions are more suited for diversified farming. However, a considerable portion of the Indian Springs soil association is occupied as Indian reserve. These soils are neutral to slightly acid in reaction and are favorable for tree growth.

Tree Culture Projects Recommended

1. Development of woodlots on the coarse textured, gritty, gravelly and reworked areas.
2. Maintenance of wooded strips around the cultivated fields for the conservation of the light textured portions used for arable culture.

G_2 MANITOBA ESCARPMENT.

Including:

(a) Pembina Hills Section,

(b) Assiniboine Delta Section,

(c) Riding Mountain Section.

(a) *Conditions, Characteristics and Problems of the Pembina Hills Section*

A large number of soil types occur on the eastern slopes of the Manitoba escarpment. On the slopes and bench lands of the Pembina section are found the Pembina clay loams (grey-wooded soils on boulder till); Leary sandy loams to sandy clays (wooded soils developed on light textured beach and lake terrace deposits); Agassiz soils (blackearth soils developed on gravel and sand beach deposits); Blumenstein complex (black to grey-black and salinized soils on wave-sorted and stony boulder till); Benton soils (bad structured soils on weathered dark shale, containing bentonitic clay); Gretna clay, wooded associate (developed on grey cretaceous clay); and eroded slopes and steep ravines cut into the shale.

With the exception of the Benton and the Agassiz soils, this section of the escarpment is well suited to the production of trees. The native growths consist of poplar, oak, ash, elm, basswood and Manitoba maple, with hazel and cherry as undergrowth. The presence of such eastern species as sumac, fern and Canadian ginger indicate favorable tree growth conditions.

Tree Culture Projects Recommended

1. Maintenance of woodlots on the relatively steep slopes and ravines of the escarpment.
2. Establishment and preservation of treed strips on the arable bench lands to aid in soil erosion control.

(b) *Conditions, Characteristics and Problems of the Assiniboine Delta Section from a Tree Culture Standpoint*

This section includes the Firdale soil association occurring on the slopes and above the crest of the escarpment where it crosses the Assiniboine delta. The Firdale soils are grey-blacks developed on fine sandy loam to clay loam textured deposits with hilly or rolling topography. Some of the trees have been cleared from the area, but the prevailing native vegetation is a woodland cover of poplar and oak. The slopes and indentations cut into the escarpment are quite steep in many places, and the material on which these soils are formed is very susceptible to sheet and gully erosion. Hence, it is important that a sufficient cover of trees (or other perennial crops) be maintained on the soils of this association to prevent soil erosion.

Tree Culture Projects Recommended

1. Maintenance of tree cover on the steep slopes, ravines and gullies.
2. Establishment and maintenance of treed contour strips for erosion control on the cleared portions.

(c) *Conditions, Characteristics and Problems of the Riding Mountain Section from a Tree Culture Standpoint*

The soil types of the Riding Mountain Section have not yet been established. The area in general consists of the steep slopes and bench lands of the eastern face of the escarpment. The escarpment is broken and channelled by deep ravines cut into the cretaceous shales. Weathered shale outcrops at or near the surface in many places, especially on the upper slopes, and colluvial deposits eroded from the higher slopes occur extensively on the lower slopes and the bench lands. Prior to settlement the area was well wooded with coniferous and deciduous trees characteristic of the mixed woods of the boreal forest. This indicates favorable conditions for the reproduction and growth of trees. A considerable portion of the bench land towards the base of the escarpment has been cleared and put under arable culture. Here the soils are very subject to erosion. The higher portion of the escarpment is a National Park. The rougher portions of the escarpment below the forest reserve are also under tree growth, but the original growth has been more or less modified by fire and cutting.

Tree Culture Projects Recommended

1. Maintenance of forest conditions on the slopes of the mountain and in the ravines for the production of wood, for the protection of the surface from erosion, for water conservation and for run-off control.
2. Establishment and maintenance of treed strips on the contours of the cultivated areas and on the bench lands to aid in the control of erosion.

G_3 TURTLE MOUNTAIN AREA—TURTLE MOUNTAIN SOIL ASSOCIATION.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

The Turtle Mountain soil association consists of grey-wooded and grey-black soils developed on boulder till with morainic topography on the crest and upper slopes of the elevation known as Turtle Mountain. The forest vegetation which covers these soils forms an island of woods surrounded by grassland. The higher altitudes are responsible for higher moisture efficiency and lower temperature, and these in turn are responsible for the invasion of forest into the grassland region. A severe fire occurred in the eighties which destroyed the original stand of timber. The present tree growth, however, which ranges approximately from the 1900-foot contour to the crest of the mountain, is vigorous and appears to be more or less zoned in a concentric ringed pattern. The trees occurring nearest the prairie are oak, or oak and aspen; followed by a mixture of aspen poplar, balsam poplar, ash, elm and maple. As the higher altitudes are reached, paper birch and poplar become the dominant trees. Although this is an excellent site for tree growth, no conifers have been noted in the virgin woods. However, plantings of white spruce and Scots pine made by the Forest Service have made good growth. About half of the wooded area is in forest reserve. The wooded area outside of the reserve is at the lower altitudes where grey-black and grey-wooded soils occur in a complex pattern, and where oak and poplar are the dominant vegetation.

Tree Culture Projects Recommended

1. Protection and maintenance of private woodlots as a source of wood, fence posts, etc.
2. Maintenance of the woods for control and conservation of water.
3. Large scale clearing of bench lands should be avoided. The rougher topography should be kept under forest, and where clearing is undertaken to give arable lands, such clearing and breaking should be on the contour with forested strips left for erosion control.
4. Conifers should be introduced into private woodlots and field strips to give a variety of woods.

Wooded Valleys of Rivers and Streams (W)

W_1 DEEP VALLEYS OF RIVERS AND STREAMS ERODED INTO SHALE WEST OF THE ESCARPMENT.

Including:

The Assiniboine valley with its deep tributary valleys, i.e.,

- The Shell, the Bird-tail and Minnedosa Valleys,
- The Qu'Appelle Valley,
- The Souris Valley and its tributaries.

The Pembina Valley and its tributaries.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

These valleys are invariably eroded through the surface deposits into the underlying shales. They are deep and have relatively steep sides or slopes. On the slopes in different places there is either a shallow covering of soil material, or an exposure of shale, more or less weathered. The valleys vary in type from V-shaped to U-shaped. The V-shaped valleys have steep slopes and may have little or no bottom lands. Where they are wooded, oak predominates on the higher slopes and drier sites, grading into oak and poplar with scattered ash. The U-shaped valleys also have steep slopes with similar vegetation, but in addition they have a more or less flattened valley floor or flood plain on which elm, maple, birch, balsam poplar and willows, and sometimes basswood, are found, along with aspen poplar.

In the drier portions of the prairie and aspen grove region, the banks with northern and eastern exposures are wooded, but the banks with southern and western exposures are more or less covered with a growth of short grasses and artemisia; and trees (if present) are confined to the ravine-like gullies in which trapped snow provides additional moisture.

In the more moist portions of the prairie and aspen grove region, the deep valleys are more or less wooded along and up the slopes of both banks. These steep river banks are unsuited for agriculture, and where woods occur naturally on the shallow soils and weathered shales, they should be maintained as controlled woodlots for erosion control and for snow and water conservation.

Tree Culture Projects Recommended

1. Maintenance of native woods and the introduction of tree types suitable to the varying conditions on the slopes and in the valleys.
2. Investigation to ascertain what other tree species would be suitable for introduction.
3. Maintenance of wooded vegetation to check run-off, to conserve snow and to provide protection for wildlife.
4. Development of native berry bushes and hardy fruit plants in the valleys, in conjunction with the improvement of woodlots.
5. The possibility and desirability of using sections of the valleys as routes for scenic highways should be considered.

W_2 RELATIVELY SHALLOW RIVER AND STREAM VALLEYS WITH ADJACENT FLOOD PLAINS.

Occurring east of the escarpment in the Lake Agassiz basin. Including:

(a) The Red River channel and its tributary streams, i.e., the Assiniboine, La Salle, the Marais, the Seine, the Rat, the Marsh and the Roseau Rivers.

(b) The wooded portion of the channels of the discontinuous streams east of the escarpment, as well as the Boyne or Morris River, Tobacco Creek, Dead Horse Creek, etc.

(c) The Whitemud and its tributaries flowing into Lake Manitoba.

(d) The streams with wooded valleys flowing into Lake Dauphin.

Conditions, Characteristics and Problems from a Tree Culture Standpoint

These stream valleys and relatively shallow channels are of recent geological origin. Because of the shallow nature of the channels, ice jams sometimes cause overflow of flood waters from melting snows, so that in many cases flood plains of varying widths, and natural levees have been developed. Here, generally, the river terraces, the higher flood plains, and the crests of the river banks have provided a favorable site for the growth of native woods. Thus, woodlands in the prairie and aspen grove region east of the escarpment consisting of oak, and oak and poplar are frequently found as a narrow fringe or ribbon of forest along the river banks. Poplar and oak in association with willow shrubs frequently occur on the broad upper flood plains. Elm, maple, basswood, poplar and willow, etc., are commonly dominant on the river terraces below the banks. Although fairly heavily wooded, the soils of the flood plains and the river terraces are invariably excellent garden lands, and the wooded fringe along the river banks makes excellent home sites.

Tree Culture Projects Recommended

1. Development and preservation of the wooded fringe along the river banks for woodlot purposes and for home and building protection.
2. Maintenance of treed strips around the fields and property boundaries, and the retention of specimen trees for shade and other purposes on the cleared portions of the river terraces, should be encouraged. These river terraces make excellent market garden sites and the river flood plains make excellent agricultural lands. Where clearing of the heavy woods formed on these sites is necessary, wholesale clearing should be avoided.
3. The development of the natural parks for picnic grounds where wooded river terraces are close to main highways should be considered.

(3) Forested Region

(a) Alienated lands in the Forest Region.

(b) Crown lands in the Forest Region.

(*a*) *Alienated Lands in the Forest Region:*

In the forested region, trees occur and propagate themselves naturally. The vegetation on the unbroken land in this region should be conserved and put under an appropriate forest management control.

Tree Culture Projects Recommended

The woodland program on the alienated land in this region should include:

1. The introduction and development of co-operative or community projects for the production, management and marketing of forest products.
2. Extensive clearing of forested lands for arable culture should be avoided, especially on the light textured soils. Strips of trees should be retained and maintained close enough together to prevent injury from soil drifting.
3. On the forest soils that have sufficient slope to cause accelerated run-off, the fields should be broken and worked along the contours, and separated by unbroken wooded strips.

(*b*) *Crown Lands in the Forest Region:*

The forests on the Crown lands in the forest region do not come within the scope of a woodlot and shelterbelt program for Manitoba. They are under the jurisdiction and protection of the Forest Service of the Provincial Department of Mines and Natural Resources.

V. SUMMARY OF FARM FORESTRY AND TREE CULTURE PROJECTS RECOMMENDED FOR MANITOBA

The various farm forestry and tree culture projects recommended for the varied conditions as outlined in Section IV are tabulated for convenience of ready reference in summary form in Table No. 4.

TABLE NO. 4—SUMMARY OF FARM FORESTRY AND TREE CULTURE PROJECTS

Regional Zonal and Local Soils	Woodlot Projects	Field Shelterbelts, Windbreaks or Hedges	Farmstead Shelterbelts, or Windbreaks
(1) Grassland Region SOUTHWESTERN MANITOBA. *Dark brown-blackearth soil zone.*			
D_1 Waskada soils.	Not recommended.		Renovation and re-establishment of farmstead shelterbelts by the use of relatively drought resisting tree species under methods of management designed to combat drought (i.e., narrow tree belts in duplicate, etc.).
D_2 Whitewater soils.			
D_3 Cartwright—Bede soil complex.			
(2) Prairie and Aspen Grove Region *Blackearth soil zone.* B_1 Soils developed on boulder till.			
(a) Oxbow soil association.	Maintenance and development of the natural "ring-like" growths of aspen occurring in the intermediate positions surrounding the undrained depressions, for (a) Woodlots. (b) Game bird protection. Introduction of other species of utility trees, and the adoption of suitable woodlot management practices.		As Waskada; but instead of straight row plantings, the farmstead shelterbelts should be arranged on positions of favorable growth sites and according to the topographical features. Planting on the knolls or low hillocks, and on saline areas should be avoided.
(b) Hilton—Tiger Hills complex.	Maintenance and improvement of natural "hillside woodlots" on northern and eastern slopes. Introduction of other species of utility trees, and the adoption of suitable forestry or woodlot practices.		As for Oxbow.
(c) Darlingford—Manitou combination.			
1. Darlingford soil association.	Combined farmstead, shelterbelt and woodlots. Tree species selected should be suited to the topographical positions.	....	Renovation and maintenance of established farmstead shelterbelts and combined shelterbelts and woodlots.
2. Manitou soils.	As Darlingford, plus maintenance of woodlots on mounds of shale outcrop. (Oak islands.)	Field shelterbelts for soil erosion control.	As Darlingford.
3. Snowflake soils.	As Darlingford.	....	As Darlingford.
B_2 Soils developed on gravelly deposits.			
(a) Marringhurst soils.	Require investigation.		
(b) Agassiz soils.	Require investigation.		
B_3 Soils developed on sandy or light textured deposits. (a) Light textured soils of the Souris basin. (Souris sands.)	Experimental areas to determine adaptation of tree species for growth site conditions. Protection of previously wooded sites and extension of woodlot development in the duned and associated moist sandy areas as private or municipal woodlots, or Establishment of forest reserves on such areas.	Development of an extensive system of field shelterbelts for soil drifting control on all arable soil areas.	Renovation and maintenance of farmstead shelterbelts.

Recommended for Manitoba (Based on Regional and Local Conditions)

Other Projects	Town and Village Plantings	Remarks
Tree and shrub planting for protection around gardens and dug-outs, and to trap snow.	Planting of relatively drought tolerant specimen and shade trees for street planting, and for ornamentation of cemeteries, etc.	Chief problem—Severe periodic drought.
		Chief problem—Flat topography and clay texture with impeded drainage and alkalinity (saline soils). Not generally suited to trees.
		Chief problem—Gravelly texture and alkalinity. Not generally suited to trees.
As for Waskada.	As for Waskada.	Chief problems—Droughty knolls and hillocks; periodically wet depressions; local saline depressions; and occasional severe drought.
As for Waskada, but care should be taken to avoid locating dug-outs and protecting hedges on alkali or saline soils in the low positions.	As for Waskada.	Chief problems—Droughty knolls and hills; dry slopes with southern and western exposures; saline soils and calcareous soils with alkaline reaction.
	Renovation and improvement of town and village plantings.	Generally favorable for trees. (Occasional drought.)
	As Darlingford.	Favorable reaction for tree growth. Manitou soils are very susceptible to erosion by wind. Protection from wind is necessary to prevent soil eroding from the underlying shale.
	As Darlingford.	Chief problems—Local imperfect drainage and soil alkalinity.
		Droughty gravelly subsoils and substrata. An investigation should be undertaken to ascertain the suitability of the various local areas for woodlot purposes, and the adaptability of the different tree species to the various site conditions.
	Renovation and extension of town and village plantings.	Favorable for trees, periodic atmospheric drought and light soil, but has moist substrata with natural sub-irrigation.

Table No. 4 (Cont'd)—Summary of Farm Forestry and Tree Culture Projects

Regional Zonal and Local Soils	Woodlot Projects	Field Shelterbelts, Windbreaks or Hedges	Farmstead Shelterbelts, or Windbreaks
(b) Sandy textured soils of the upper Assiniboine delta. (Stockton sands and dunes.)	Extension of woodlot development and coniferous plantings on duned areas and associated Stockton sands, as community or municipal projects. Extension of forest reserve boundaries and intensification of afforestation program.	Field shelterbelts should be used for soil protection wherever fields are put under arable culture.	
(c) Light textured soils of the lower Assiniboine delta. (Almasippi light sandy loams.)	Conservation and protection of native wooded areas. Combination of woodlots and field shelterbelts, supplementing native types by introduction and planting of other species of utility woods. (Conifers.)	Utilization of natural islands of trees, supplemented by planting as required to protect cultivated fields from wind erosion.	Renovation and maintenance of farmstead shelterbelts.
(d) Sandy soils of the Red River Plain. Altona soils— (Light phase.)	Possible woodlot development in conjunction with farmstead shelterbelts and field shelterbelts.	Systematic field shelterbelts for soil drifting control.	Renovation and improvement of established farmstead shelterbelts.
B_4 Soils developed on medium to fine loam textured lacustrine sediments. Carroll soils. Glenboro soils. Holland soils. Wellwood soils. Portage soils. Altona soils (better phase). Emerson soils, etc.		Development of field shelterbelts and hedges for protection of soil from drifting.	Renovation and improvement of farmstead shelterbelts.
B_5 Soils developed on heavy textured deposits. (Red River clays, Gretna clays, Morden silty clay, etc.)	If woodlots are desired, a system of combined woodlot and shelterbelt could be used.		Extension and development of farmstead shelterbelts.
B_6 Soils developed on mixed textured water worked deposits.	Conditions very variable. Local areas only are favorable.		
Northern blackearth soil zone. N. Soils developed on boulder till. (Newdale soils.)	Conservation of present wooded sites, and improvement of woodlot possibilities by the introduction of new species (conifers) and the adoption of appropriate management practices.		Renovation and improvement of plantations, and of native aspen groves, used as farmstead shelterbelts.
Dark colored high-lime soil zone. H. Soils developed on modified drift and lake washed till.	Conservation of the native treed areas, and investigation of the forest management methods required to insure maximum production under the varied conditions.		
Forested islands and islands of woodland invasion. G_1 Pembina Hills area. (a) Soils developed on boulder till. (Pembina Hills soils.)	Conservation of the native woods on the unbroken land. Improvement of the native wood lots by the introduction of new species. (Conifers.)	The retention of native trees and shrubs, or the planting of treed strips on the contours between cultivated fields on the stronger slopes.	Preservation and maintenance of tree growth around farmsteads and building sites, and improvement of the native shelterbelts by ornamental planting.
(b) Soils developed on waterlaid sediments. (Altamont soils, medium heavy.)	Preservation of islands of oak, etc., on mounds of shale outcrop. (Altamont soil association.)		Preservation and maintenance of farmstead shelterbelts.
(Indian Springs, sandy.)	Woodlot development on the more sandy and coarse textured portions. (Indian Springs soil association.)	Maintenance of treed strips or development of hedges as field shelterbelts for soil drifting control on the sandy loam portions. (Indian Springs soil association.)	

Recommended for Mamnitoba (Based on Regional and Local Conditions)

Other Projects	Town and Village Plantings	Remarks
Planting for landscape effect along the highways. Fit plantings to the landscape.		Chief problems—Sandy soils not generally suited to agriculture, and subject to surface drought.
	Renovation and improvement of town and village plantings.	Very favorable for tree growth. Light textured soils with moist subsoil. Chief problem—Soil drifting unless adequately protected.
	Renovation and improvement of town and village plantings.	Generally favorable for tree culture but with local soils of alkaline reaction.
	Renovation, improvement and extension of town and village plantings.	Invariably good agricultural soils. Tree production is not a serious problem where tree planting is required for erosion control.
Use of hedges for protection of drainage ditches and earthworks from soil drifting. Combination of trees (including fruit trees and shrubs) as supplementary plantings for landscape effect in conjunction with hedges planted to protect roads from snow drift.	Development of tree planting in towns and villages.	Favorable for trees where the soils are not saline or under the influence of poor drainage. Fort Garry clays have calcareous sandy clay subsoils, and are not as favorable for tree culture as the Red River clays.
		Extensive soil variability.
	Improvement of plantings in towns and villages.	Transition from prairie to forest; area is favorable for tree growth except in local saline depressions.
Experiments should be conducted with trees that have a higher tolerance for alkaline soil conditions than the native aspen.	Investigations required to determine the best type of trees for the high-lime soil conditions that prevail.	Chief problems— General alkaline soil reactions and the presence of free lime carbonate in the soil. Local areas of shallow soil with rock close to the surface and local areas with impeded drainage and alkaline reaction.
	Renovation and improvement of town and village plantings.	Trees reproduce naturally. Under virgin conditions trees are dominant vegetative cover, but there is an absence of conifers which could be remedied by the introduction of mother trees.
	Renovation and improvement of town and village plantings.	Altamont soils are good agricultural lands, and trees could be utilized for soil protection as required. Indian Springs soil association contains areas of low agricultural value, that are suitable for tree production.

TABLE NO. 4 (CONT'D)—SUMMARY OF FARM FORESTRY AND TREE CULTURE PROJECTS

Regional Zonal and Local Soils	Woodlot Projects	Field Shelterbelts, Windbreaks or Hedges	Farmstead Shelterbelts, or Windbreaks
G_2 Manitoba escarpment area.			
(a) Pembina Hills section.	Maintenance of forest or woodlots on the steep slopes of the escarpment and of the ravines.	The use of treed strips along the contours on the bench land for soil erosion control where cultivation is practised.	As Pembina Hills area.
(b) Assiniboine delta section.	Maintenance of native woods on the stronger slopes and on the knolls where the soils are shallow.	Fields should be laid out along the contours with buffer strips of native trees or planted shelterbelts.	
(c) Riding Mountain section.	Maintenance of forest condition on the slopes of the mountain or escarpment and in the deep ravines, for water and soil conservation, as well as for production of forest products.	As for Pembina Hills section.	
G_3 Turtle Mountain area.	Protection and maintenance of private woodlots as a source of wood, fence posts, etc. Introduction of conifers for variety. (Farm forests outside of reserve.)	Large scale clearing should be avoided and fields should be cleared as contour strips, protected by strips of native trees. (Introduction of conifers for variety.)	As Pembina Hills area.
Wooded valleys of rivers and streams.			
W_1 Deep valleys of rivers and streams eroded into shale west of the escarpment.	Maintenance and introduction of tree types suitable to the varying growth site conditions on the slopes and in the valleys. Investigation to ascertain which tree species (if any) would be suitable for introduction to the various positions and growth site conditions on the slopes.		
W_2 Relatively shallow river and stream valleys with adjacent flood plains east of the escarpment.	Preservation and development of the wooded banks and the wooded fringes on the adjacent upland for woodlot purposes and for homesite and building.		The preservation of the best native trees around the building sites, and supplementing these with ornamental plantings.
(3) Forest Region			
(a) Alienated lands in the forest region.	The woodlot or forestry program here required is the introduction and development of co-operative or community projects for protection, management, and marketing of forest products.	See under other projects.	As Pembina Hills area.
(b) Crown lands in the forest region.	The forest program on the Crown lands is taken care of by the Forest Service, Provincial Mines and Natural Resources Department.		

Recommended for Manitoba (Based on Regional and Local Conditions)

Other Projects	Town and Village Plantings	Remarks
		Escarpment in general favors tree production, with the exception of the portions where Benton soils occur or weathered shale outcrops, and where the deep ravines are cut into the shale. (The steep slopes of the ravines and the presence of shale at or near the surface present problems in the establishment or maintenance of tree cover.)
		Hilly topography, very susceptible to soil erosion. (Firdale soil association.)
		Chief problems—Fire protection when under forest, and excessive run-off due to steepness of slopes when land is cleared
		As Riding Mountain section, Manitoba escarpment, with the additional problem of summer frosts.
Maintenance and use of the wooded vegetation for snow and water conservation, and for the protection of wild life. Development of native berry bushes and hardy fruit plants in the valley in conjunction with woodlots. The possibility and desirability of using sections of these valleys as routes for scenic highways should be considered.		Chief local problem—Droughty condition, especially on the upper slopes cut into shale and on the slopes with western and southern exposures.
Excessive clearing of the river terraces and flood plains should be avoided. Strips or irregular areas of the excellent native woods, as well as desirable specimen trees, should be retained to maintain the attractiveness of the farms and market gardens on these highly productive areas.		Excellent sites for tree production, and under virgin conditions support a wealth of native hardwoods.
Excessive clearing of forested land for arable culture should be avoided, especially on light textured soils. In clearing land, strips of trees should be retained and maintained close enough together to prevent injury from soil drifting, also tree strips should be left on the contours for erosion control where the topography is hilly.		Trees reproduce naturally. The chief problem is conservation and protection from exploitation and fire.

ILLUSTRATION No. 27

Native woodlot, showing healthy stand of pure aspen poplar.
(Photo by courtesy Dominion Forest Service.)

ILLUSTRATION No. 28

Native woodlot, showing mixed stand of white spruce and aspen poplar.
(Photo by courtesy Dominion Forest Service.)

VI. ESTIMATE OF ACREAGES INVOLVED IN THE RECOMMENDATIONS FOR FARM FORESTRY AND TREE CULTURE PROJECTS IN MANITOBA

In the foregoing sections of this report, an attempt has been made to give a fairly comprehensive picture of the natural tree distribution in the province; of the areas that are naturally unfavorable for tree growth and reproduction where extreme caution in tree planting is necessary; and of the conditions, characteristics and problems in favorable areas, where specific types of farm forestry or tree culture are required and can be carried on successfully.

In this section of the report an attempt is made to estimate the approximate acreage to which the foregoing recommendations for farm forestry and tree culture would apply. The figures given for the respective acreages are not intended to be absolutely accurate and inflexible, but they do represent a carefully considered opinion based on field observation and study of soil survey maps, and hence they are much more than a rough estimate. The acreage figures are submitted to show the extent of the work involved in the respective projects.

A. Woodlot Areas:

The areas for which woodlots are recommended as the major project can be listed under two main headings: (1) Natural woodlot areas requiring maintenance and improvement, and (2) areas suitable for afforestation.

(1) NATURAL WOODLOT AREAS REQUIRING IMPROVEMENT AND MAINTENANCE:
Types of woodlots:

	Acres	*Acres*
(a) Small groves occurring as fringes of poplar and willow around poorly drained non-saline depressions.		
Estimated area for small natural private woodlots scattered over farms (as in Oxbow soil association).........	45,000	45,000
(b) Hillside and other natural woodlots of somewhat restricted extent (more or less stony) occurring on favorable local slopes and sites.		
Estimated area for private hillside woodlots as in Tiger Hills soil complex..................................	40,000	
As in Newdale soil association.......................	234,000	
		274,000
(c) Extensive hillside woods on the relatively steep slopes or rough topography of the Manitoba escarpment, and on Turtle Mountain outside of forest reserve, where private and municipal woodlots could be maintained.		
As on Manitoba escarpment:		
Pembina Hills Section..........................	60,000	
Assiniboine Delta Section........................	33,000	
Riding Mountain Section........................	36,000	
As on Turtle Mountain Section (Outside of Prov. Forest Reserve)................	92,000	
		221,000
(d) Woods on the steep slopes of the deep river valleys and ravines west of the escarpment, or occurring in the Pembina and Assiniboine Valleys, where private and municipal woodlots could be maintained...	170,000	170,000
(e) Woods on river terraces, flood plains and as a fringe along the banks of the shallow stream channels, east of the escarpment, where private woodlots could be maintained................	95,000	95,000
(f) Wooded areas formed as a result of woodland invasion of prairie, where private or municipal woodlots could be maintained:		

As in:

Darlingford soil association	7,500	
Manitou soil association	3,000	
Snowflake soil association	12,500	
Pembina Hills soil association	39,000	
Altamont soil association	2,000	
Indian Springs soil association	6,000	
		70,000

Estimate of total area of natural woods where private or municipal woodlots could be established, maintained and improved	875,000

(Large poplar groves also occur on the Almasippi soils of the lower Assiniboine delta.)

(2) Areas suitable for afforestation:

Light textured soil areas that are partially wooded, but may be improved and the production increased by the introduction of suitable tree species and by the adoption of approved silviculture or forestry management methods: areas are of size suitable for provincial, municipal or community forestry projects.

	Acres	*Acres*
Souris sands and dunes (in Lake Souris basin)	148,000	
Sands and dunes of the Upper Assiniboine delta outside of present Spruce Forest Reserve	270,000	
Sands and dunes of Lower Assiniboine delta	46,000	
Estimate of total area of land (sands and dunes) unsuited for arable culture but suitable for afforestation to pine, spruce, etc.		464,000

Total area outside of forest region where successful woodlot development is indicated and recommended:

Natural woodlot areas	875,000	acres
Areas recommended for afforestation	464,000	"
	1,339,000	"

B. Field Shelterbelts:

The areas where field shelterbelts are needed and recommended as an aid in soil erosion control (and where the soil moisture is favorable for trees) may be grouped under two headings:

(1) Areas where field shelterbelts should be used as an aid in soil drifting control.

(2) Areas where field shelterbelts or hedges should be used on contours as an aid in the control of water erosion.

(1) Areas where field shelterbelts should be used as an aid in soil drifting control:

These areas may be listed under two headings, according to their susceptibility to soil drifting and to the urgency of installation.

(a) Areas where the soils are very susceptible to wind erosion or soil drifting,* and where immediate steps are required. (The figures given show the acreage involved and the miles of hedges or shelterbelt required to protect the soils on the basis of 3 miles of hedge per quarter section.)

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*These areas can be located on sketch map Figure No. 4 by the dot symbols used to designate sandy sediments. (See map and legend.)

Arable sandy soils:

Souris soil association	372,000	acres
Stockton soil association	188,000	"
Almasippi soil association (combined planted and natural woods)	724,000	"
Altona light loams	65,000	"

Arable soils on cretaceous shale clay:

Manitou clay loam	107,000	"
	1,456,000	"

Sub-total of miles of field hedges or shelterbelts (a) . . . . 27,300 miles (The Lyleton Field Shelterbelt Association has already planted 245 miles of field hedges in an area of 42 square miles.)

(b) Areas where the soils are somewhat less susceptible to wind erosion than (a) but in which field shelterbelts should be introduced as a preventive or soil conservation measure.*

Arable soils on fine loam lacustrine sediments, including:

Carroll soil association	527,000	acres
Glenboro soil association	48,000	"
Holland soil association	38,000	"
Wellwood soil association	57,000	"
Portage soil association	94,000	"
Altona (fine loam to clay loam)	157,000	"
Emerson soil association	109,000	"
Sperling soil association	14,000	"
Beresford soil association	40,000	"
Schoenwiese soil association	14,000	"
	1,098,000	"

Sub-total of miles of field hedges and shelterbelts (b) . . . . 20,580 miles

(a) + (b) — Total miles of hedges and shelterbelts recommended as systematic field plantings to aid in soil drifting control . . . . 47,880 miles

(2) AREAS WHERE FIELD SHELTERBELTS OR HEDGES SHOULD BE USED ON CONTOURS AS AN AID IN THE CONTROL OF WATER EROSION:

The areas for which field shelterbelts are particularly recommended, as an aid in water erosion control, are the cultivated lands on the strong slopes occurring on:

Turtle Mountain,

Tiger Hills,

Manitoba escarpment:

(a) Pembina Hills section,

(b) Assiniboine delta section,

(c) Riding Mountain section.

West slope of Riding Mountain, and local areas of rolling phase of Carroll and other soil associations.

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*These areas can be located on sketch map Figure No. 4 by the broken horizontal lines used to designate medium to medium heavy lacustrine sediments.

Most of these areas (except the Carroll soils) were naturally wooded. Where fields are cleared out of forest or natural woods on the rolling or hilly areas, field shelterbelts of native trees and shrubs should be left as contour strips. Where clearing has been excessive or where trees are absent, and erosion by water is threatened, field shelterbelts or hedges should be planted around the slopes and on the contours of arable fields to slow down water run-off, for snow retention, and as a soil conservation measure.

No estimate is available of the miles of hedges and shelterbelts required, as in many cases the necessary protection can be obtained by judicious use of native vegetative growth

C. Tree and Shrub Planting for Highway Protection:

A communication from the Highways Branch makes this statement regarding the prospective requirements for hedges along highways:

> "For post-war program this department has plans for increasing the trunk highway system to 3,280 miles and a secondary highway system to 2,166 miles over a ten-year period. Of this mileage, approximately 166 miles are at present planted with hedges, leaving a total mileage of 5,280 miles to be considered. This mileage would not all be planted with hedge, but the percentage will no doubt be higher than the 10% on the existing trunk highway system. For an estimate, I am assuming 50% of the mileage will be planted. This would require 12,200,000 plants on a basis of 5,000 plants per mile, excluding replacements. The yearly replacements on the basis of 1945, would be approximately 10% of existing hedges at that year."

It is suggested, however, that there are further possibilities in highway planting if market roads also are taken into consideration. The concrete, bituminous and gravelled roads in Manitoba are listed in 1943 as, 36.76, 500.15 and 8,208.53 miles respectively, or a total of at least 8,745 miles of improved roads; and there is more than ten times this mileage of road allowance in the organized portion of the province.

D. Tree and Shrub Planting for the Protection of Drainage Ditches:

The Drainage Maintenance Board gives an estimate of 65 miles of drainage ditches that should be protected with hedges in the near future. This mileage could be increased many times as the principle of hedge planting became established on the heavy soils that require drainage.

The area of heavy textured soils with somewhat flat topography in the Red River Valley is as follows:

Heavy Soils in Red River Valley:

			Acreage
Morden soil association			27,000 acres
Gretna soil association			100,000 “
Myrtle soil association			84,000 “
Red River Soils	Well drained	279,972 acres	2,297,000 “
	Well drained (wooded)	53,142 “	
	Well drained (alkaline)	258,539 “	
	Poorly drained (saline)	170,714 “	
	Poorly drained (non-saline)	264,591 “	
	Heavy textured soils (unsurveyed)	1,270,042 “	
Red River-Emerson Transition Soils			34,000 “
Burnside soil association			18 000 “
Westbourne soil association			57,000 “
Alluvium			27,000 “
			2,644,000 “

If 40 per cent. of this area had one drainage ditch per mile it would require 1,600 miles of drains, and hence an estimate of over 1,000 miles of protective hedges may be given.

E. Areas requiring investigation:

(1) Soils on mixed textured, eroded and water worked deposits in which certain problems are encountered in tree production.

These variable textured soils have a differential effect on internal drainage. Where internal drainage is arrested, saline or alkaline conditions may be found. The suitability of these soils for trees is doubtful. The indications are that they are not generally suited and should not be recommended for extensive tree culture. The non-arable soils are apparently better suited to the production of grass. Soils in this group include:

Heaslip soil association	222,000	acres
Greenway soil association	14,000	"
Blumenstein soil association	4,000	"
Hecla soil association	44,000	"
Rea soil association	29,000	"
Lenore soil association	41,000	"
	354,000	"

(2) Gravel and coarse sandy soils, that are either excessively droughty or alkaline in reaction.

These soils are developed on gravel, coarse sand and sand. They are subject to drought and their suitability for trees is very doubtful. Further studies and field investigations of these areas should be undertaken to ascertain the forms of land use to which they are best suited.

Bede soil association	99,000	acres
Marringhurst coarse sand and gravel	349,000	"
Aggasiz sands and gravel	55,000	"
Cartwright soil association	25,000	"
	528,000	"

(3) Rendzina or high-lime soils:

These are shallow dark colored high-lime soils. The high lime condition limits the trees that will grow, and predisposes to chlorosis. Tree growth is limited and subject to premature death. In parts of the area, the presence of rock close to the surface restricts root room and there are large areas under the influence of imperfect drainage.

Dark colored high lime soils with adverse soil reaction, etc:
Constitute approximately..4,446,000 acres

Experiments and studies should be undertaken on these soils that are developed either on badly mixed deposits, or on gravelly coarse textured and calcareous minerals, in order that their respective suitability for tree culture may be ascertained. It would be unwise to attempt the formulation of any forestry program on such problem soils until further information is available.

F. Farmstead Shelterbelts or Windbreaks and Village Planting:

Renovation of farmstead shelterbelts or windbreaks, and renovation and improvement of town and village plantings are required in all areas throughout the province.

The Dominion Census figures for 1941* list the number of occupied farms in Manitoba as 58,022. No accurate data are available in respect to the number of farmstead shelterbelts or windbreaks on these farms. A certain number of these farms are in the forest region, and a larger number are in the aspen grove region, hence it is evident that many farmsteads are located on sites that are protected naturally to a greater or lesser degree by native woods.

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*Eighth Census of Canada, 1941, Bulletin No. 48.

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The Dominion Census figures for 1936** show that forest products are cut on 23,831 Manitoba farms. If these figures are indicative of the number of farms where there are sufficient native trees to provide natural protection for building sites, the difference between the two records may be taken as an indication of the number of farms where adequate protection is not provided naturally (i.e., 58,022 — 23,831 = 34,191).

In the open prairies the tree planting materials used were first obtained by the settlers from the native woods. (See Appendix 2.) From 1891 to 1900 forest tree seedlings were distributed from the Brandon Experimental Farm in bundles of 100 and 175; tree seeds were also distributed from the same source. During this 10-year period an average of 625 applicants per year were supplied with these bundles of seedlings (or over 6,000 individual deliveries). How many of these were repeat orders is not known. Neither does there appear to be any record of the number of tree plantations grown from commercial nursery stocks.

From 1901 to 1944 the number of farm shelterbelts in Manitoba planted with seedlings and cuttings obtained from the Dominion Forestry Station, Indian Head, are recorded as 10,545.*

From these records, and from a general impression gained in traversing the country, it could be estimated that some form of planted shelterbelt, or natural windbreak is to be found on 65 to 70 per cent. of Manitoba's 58,022 farms. This estimate is submitted as tentative only. It is also estimated that the establishment of farmstead shelterbelts is required on 30 to 35 per cent. of the farms; the maintenance and renovation of established farmstead shelterbelts is required on 25 to 30 per cent. of the farms; and the utilization and care of native growth for windbreaks supplemented by judicious and appropriate planting is required on 40 per cent. of Manitoba farms.

VII. TREES AND SHRUBS FOR TREE CULTURE AND FARM FORESTRY PROJECTS RECOMMENDED

For the various farm forestry and tree culture projects recommended in the grassland and prairie-aspen grove region of Manitoba (i.e., woodlots, shelterbelts, hedges, etc.), different forms of trees and shrubs are required. Although the tree species that occur naturally in the prairies, outside of the forested region, are quite limited, there is a considerable number of trees and shrubs that are either native to the forested region of Canada or of other countries in comparable latitudes from which selections can be made for any of the respective projects recommended and for specific growth sites.

The following list of native and introduced trees and shrubs arranged according to height and type of growth indicates the range of choice of material for the projects recommended. This list is not necessarily complete, but it will be found to contain suitable species that may be selected for the various tree culture projects recommended in this report.

Coniferous Trees:

Tall trees:

White spruce; jack pine; Colorado blue spruce; larch or tamarack; Siberian larch; Scots pine; lodgepole pine; red pine; balsam fir; Eastern white cedar.

Small trees:

Rocky Mountain red cedar.

Dwarf spreading:

Mountain pine.

Broad Leaved Trees and Shrubs:

Upright, tall, single stemmed, broad leaved trees:

Cottonwood; white or American elm; green ash; balsam poplar; aspen poplar; bur oak; Manitoba maple.

**Census of Prairie Provinces, 1936, Volume 1, Table No. 113, Page 277.

*Private communication.

Upright, tall, more or less multiple stemmed trees:
    Basswood; white birch.

Medium trees:
    Siberian, Manchurian, or dwarf Asiatic elm; American mountain ash; Siberian crab apple.

Small tree-like:
    Choke cherry; pin cherry.

Bushy broad leaved trees (relatively tall):
    Sharp leaved willow; bronze golden willow; golden or yellow willow; peach leaved willow; laurel leaved willow; French or Russian red willow.

Small bushy trees and large shrubs:
    Wild plum; heart leaved willow; buffalo berry; saskatoon; long spined hawthorn; caragana (Siberian pea tree); tatarian honeysuckle; Russian olive.

Medium and small shrubs:
    Caragana (bushy Russian pea shrub); common lilac; Villosa lilac; high bush cranberry; Siberian cotoneaster; red osier dogwood.

The characteristics, habitat, requirements and utility, etc., of the 46 trees and shrubs listed above are summarized in Table No. 5. In this table the plants are arranged in recognized botanical order.*

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*The names of the native species conform to those used in "Native Trees of Canada," Dominion Forestry Service Bulletin No. 61, and the names of the introduced species conform to those used in Rehder's "Manual of Cultivated Trees and Shrubs."

Table No. 5—Trees and Shrubs Suitable for Farm Forestry and Tree Culture

Name		Characteristics of Tree or Shrub			
Common Name	Scientific Name	Habit	Rate of Growth	Average Maximum Height in Feet	Average Maximum Age at Maturity
I. Conifers:					
Jack Pine	Pinus Banksiana Lamb.	Evergreen tree, apt to hold some of its lower branches.	Fairly rapid in early years, small saw-logs produced in 50 years.	80 ft. in forest areas, probably 60 ft. in southern Manitoba.	120 years, but should be cut at 60 to 90 years on account of prevalence of red heart-rot.
Red Pine or Norway Pine	Pinus resinosa Ait.	Evergreen tree. Sheds lower branches readily.	Slow for first 10 years, then quite rapid.	Probably 60 ft. in prairie conditions.	No data for prairie and aspen grove belt; will average around 180 years in the forests of eastern Manitoba.
Lodgepole Pine	Pinus contorta Dougl.	Evergreen tree, more apt to shed branches than Jack Pine.	Early growth, slower than Jack Pine but height in 20 years about equal.	Probably 60 ft. in prairie conditions.	Similar to Jack Pine.
Scots Pine	Pinus sylvestris L.	Evergreen tree, apt to hold some of its lower branches.	Will reach saw-log size earlier than any of the other conifers. At Camp Hughes has reached 50 ft. in 40 years.	Probably 60 ft. in prairie conditions.	Usually cut at about 80 years in Europe, but will stand much longer.
Mountain Pine	Pinus Mugo Turra.	Evergreen dwarf tree or shrub, which spreads wide and close to the ground.	Some strains grow at fair rate in early years, others are very slow.	Some strains are dwarf, others may reach a height of 15 ft. or more.	Not known under Manitoba conditions.
Tamarack or Larch	Larix laricina (DuRoi) Koch.	Sheds its needles in winter, otherwise has all the characteristics of a coniferous tree.	Grows rapidly in early life, then slowly for many years.	70 ft. in the forest but probably less on the prairie.	Will stand about 160 years in the forest.
Siberian Larch	Larix siberica Ledeb.	Sheds its needles in winter, otherwise has all the characteristics of a coniferous tree.	Grows even more rapidly than Tamarack in early stages; 33.5 ft. in 18 years at Indian Head, Sask.	No information, not grown long enough in North America.	Not known under Manitoba conditions.
White Spruce	Picea Glauca (Moench) Voss.	Evergreen tree of pyramidal shape, retaining its branches close to the ground.	Slow for first 10 or 15 years, then rapidly for many years. 50 ft. high in 40 years at Morris, Man.	90 ft. in the forest, probably 60 to 75 ft. on the prairie.	Will stand about 180 years in the forest, usually cut at about 120 years.
Blue Spruce or Colorado Blue Spruce	Picea pungens Engelm.	Similar in habit to White Spruce. Needles often bluish.	Slower than White Spruce.	Not known yet for Manitoba conditions.	Not known yet for Manitoba conditions.
Balsam Fir or Balsam	Abies balsamea (L.) Mill.	Evergreen tree, branches close to ground, bark is smooth.	Grows rapidly.	Probably 50 to 60 ft.	Rot sets in at about 80 years in forest.
Eastern White Cedar or Cedar	Thuja occidentalis L.	Evergreen tree, leaves scale-like and branches form layers.	Slow.	Probably 45 to 50 ft.	200 to 300 years in the forest, probably much less in prairie conditions.
Rocky Mountain Juniper or Rocky Mountain Red Cedar	Juniperus scopulorum Sarg.	Small evergreen tree, pyramidal shape, branches close to ground.	Slow.	10 to 20 ft., occasionally 30 ft.	No information for Manitoba.

PROJECTS IN MANITOBA, THEIR CHARACTERISTICS, REQUIREMENTS AND USES

HABITAT REQUIREMENTS				
Moisture and Soil Adaptation	Soil Reaction—Hydrogen Ion Concentration (pH) Under Optimum Conditions, 7.0 is Neutral, Under 7.0 is Acid, Over 7.0 is Alkaline	Light Requirements	Utility	Remarks
Dry to medium site conditions best; normally grows mainly on sandy soils, but will do well on heavier land.	4.5–5.0	Intolerant of shade.	Railway ties, pulp; a good shelterbelt tree.	A hardy native of our forest belt.
Not so drought resistant as Jack Pine. Grows naturally in southeastern Manitoba.	5.0–6.0	Slight shade an advantage in young plantations; intolerant of shade in later life.	Lumber, ornamental.	Recommended for general use, east of the Red River only.
Stands drought on the prairies better than Jack Pine.	No data. Probably about equal to Red Pine.	Intolerant of shade.	Railway ties, lumber; may be used in shelterbelts.	A native of Alberta.
Will grow under a wide range of soil and moisture conditions.	5.0–6.5	Intolerant of shade.	Lumber; a good shelterbelt tree; also suitable for ornamental planting.	One of the most important timber trees of Europe. Seed should be from hardy source.
Adapted to a fairly wide range of soil and moisture conditions.	5.5–6.5	Full light required.	Ornamental; also suitable for outer row in shelterbelts.	A native of the mountains of southeastern Europe, which is hardy in Manitoba.
Usually growing on wet, but reaches its largest size on well drained soils.	5.0–6.5	Will not tolerate any shade.	A hard strong wood, used as timber, railway ties, fence posts and fuel.	May be subject to larch sawfly epidemic.
Well drained sites.	5.0–6.5	Will not tolerate any shade.	Could probably be used for same purpose as Tamarack.	May be subject to larch sawfly epidemic. Native of northeastern Russia to Siberia.
Well drained soil; grows on a wide range of soil classes, but is not suitable to alkaline types.	5.0–6.0	Will stand a great deal of shade, but makes no progress until light admitted from above.	Valuable lumber and pulpwood tree and suitable for ornamental purposes. A good windbreak tree.	Has been successful in all parts of Manitoba where soil is not alkaline or saline.
Requires normal drainage and appears more suited than other conifers to soils that are slightly alkaline to neutral.	6.0–7.0	Usually grown as specimen trees, hence light requirements here have not been ascertained.	May be used in windbreaks and as an ornamental tree.	A native of the mountains of Colorado.
Requires normal drainage.	5.0–6.0	Will tolerate heavy shade, trunks frost-crack when exposed to sun.	May be used as an ornamental tree in sheltered grounds. Good pulpwood tree.	The best Christmas tree, as needles do not fall off at room temperatures.
Grows in wet soils in the forest, but seems to thrive when planted on well drained soils.	6.0–7.5	Will tolerate heavy shade for many years; not recommended for southern exposure.	Ornamental; wood is very durable, hence good for posts, poles and shingles.	Native in southeastern Manitoba and also found around north end of Lake Winnipegosis.
Fairly well adapted to dry sites, but will do better on soils of normal drainage and medium texture.	5.5–7.0	Requires good light.	Ornamental and could be used in outer rows of shelterbelt.	Native to foothills of southern Alberta.

TABLE NO. 5 (CONT'D)—TREES AND SHRUBS SUITABLE FOR FARM FORESTRY AND TREE

NAME		CHARACTERISTICS OF TREE OR SHRUB			
Common Name	Scientific Name	Habit	Rate of Growth	Average Maximum Height in Feet	Average Maximum Age at Maturity
II. Broad Leaved Trees and Shrubs:					
Aspen, Aspen Poplar or White Poplar	Populus tremuloides Michx.	Deciduous tree, smooth greenish-white bark, trembling leaves.	Fast growth in early years from root suckers.	Varies greatly with site, 25 ft. on poorest prairie, 80 ft. on the best forest sites.	About 40 years under prairie conditions, 70 years in the forest belt.
Balsam Poplar, Balm of Gilead, or Black Poplar	Populus tacamahacca Mill.	Deciduous tree, very erect habit, bark turns dark, large buds with fragrant gum.	Fast growth in early years from old stumps.	Varies greatly with site, 25 ft. on poorest prairie, 80 ft. on the best forest sites.	About 40 years under prairie conditions, 70 years in the forest belt.
Cottonwood or Eastern Cottonwood	Populus deltoides March. (P. virginiana Fourg.)	Similar to the poplars, wide, triangular, coarsely toothed leaves.	Fast growth from old stumps, continuing for 30 years or more.	From 60 to 90 ft.	60 years.
Peached-leaved Willow or Almond-leaf Willow	Salix amygdaloides Anders.	A native tree willow of large size.	Fast growth from old stumps.	40 to 60 ft.	Unknown under Manitoba conditions.
Heart-leaved Willow	Salix cordata Muhl.	A native shrub willow, dark green leaves, and produces new shoots very prolifically.	Fast growth from old stumps.	10 to 20 ft.	Growth is continuous as new shoots from root keep replacing old stems.
Laurel or Bay Willow	Salix pentandra L.	A tall exotic willow with striking dark green leaves, which hang on late in the fall.	Fast growth from old stumps.	30 to 50 ft.	Trees planted 40 to 45 years ago on Souris soils are still healthy and growing.
Golden or Russian Golden Willow	Salix alba-vitellina (L) Stokes var.	A tall exotic willow with showy yellow branches.	Fast growth from old stumps.	40 to 60 ft.	Trees planted 40 to 45 years ago on Souris soils are still healthy and growing.
Sharp-leaf Willow or Acute-leaf Willow	Uncertain, possibly S. alba calva G.F. May.	Similar to Golden Willow, but mature twigs are dark brown.	Fast growth from old stumps.	40 to 60 ft.	Will likely make height growth for over 40 years.
Britzensis or Bronze Golden Willow	Salix alba chermesina Hartig var.	Similar to Golden Willow, young twigs bright red in late winter, has a compact ovoid form.	Fast growth from old stumps.	40 to 60 ft.	No definite information.
French, Red or Russian Red Willow	Uncertain, possibly S. daphnoides Vill. or a variety of this species.	A tall exotic willow with loose branching habit; giant catkins appearing very early.	Fast growth from old stumps.	30 to 40 ft.	No definite information.
White, Paper or Canoe Birch	Betula papyrifera Marsh.	The native birch, with paper-like bark and fine spray-like branches.	Rapid growth in early years from stump or seed.	50 ft.	About 40 years under prairie conditions, 70 years in the forest belt.
Bur Oak or Scrub Oak	Quercus macrocarpa Michx.	The native oak, a tall tree on good land, sometimes scrubby when found in droughty locations.	4 ft. in 5 years from the acorn, makes even faster growth from the stump; growth rate gradually slows but trees remain healthy for many years.	65 ft. on good soil.	Sound up to 150 years in forest belt, probably less on prairie.
White or American Elm	Ulmus americana L.	The native elm, a stately tree with fan-like crown and drooping twigs.	About the same as Manitoba Maple.	70 ft. in river valleys, 40 ft. to 60 ft. on level.	150 years.

CULTURE PROJECTS IN MANITOBA, THEIR CHARACTERISTICS, REQUIREMENTS AND USES

HABITAT REQUIREMENTS				
Moisture and Soil Adaptation	Soil Reaction—Hydrogen Ion Concentration (pH) Under Optimum Conditions, 7.0 is Neutral, Under 7.0 is Acid, Over 7.0 is Alkaline	Light Requirements	Utility	Remarks
Grows on a wide range of soils, but best trees are on acid soils with normal drainage.	3.8–5.5	Full overhead light required.	Used for fuel, lumber, pulpwood and matches; makes useful nurse tree for Spruce.	Reproduces chiefly by root-suckers, hence groves or "bluffs" spread out from original trees.
Grows best in moist locations or where soils have moist substrata.	6.0–8.0	Full overhead light required.	Useful for planting in moist locations; not highly regarded for fuel.	Cuttings sprout readily.
Grows in the well drained position of a number of soil types and on a wide range of textures.	6.0–8.0	Full overhead light required.	One of the best shelterbelt trees; lumber suitable for wagon boxes, etc.	Grows readily from seed wherever moist, mineral soil is exposed at time of seed-fall. Cuttings sprout readily.
In natural state found on moist soils.	6.0–8.0	Full overhead light required.	Fuelwood, can be grown on sites too wet for other trees.	Starts from seed on river banks and occasionally in ditches. Cuttings sprout readily.
Moist soils.	6.0–8.0	Full overhead light required.	Useful for planting in sites too wet for other species. Used for rustic furniture and fence posts.	Makes very durable fence posts, although apt to be small and crooked. Cuttings sprout readily.
Moist to normal drainage.	6.0–8.0	Full overhead light required.	Shelterbelts, ornamental.	
Moist to normal drainage.	6.0–8.0	Full overhead light required.	Shelterbelts, ornamental, fuelwood.	Widely planted.
Moist to normal drainage.	6.0–8.0	Full overhead light required.	Shelterbelts, a good fuel willow.	Recommended by nursery men in western Manitoba.
Moist to normal drainage.	6.0–8.0	Full overhead light required.	Shelterbelts, ornamental.	A newly introduced variety of considerable promise.
Moist to normal drainage.		Full overhead light required.	Shelterbelts, ornamental.	Has been used extensively by Forest Service for hedges.
Moist to well drained soil; favors cool and moist sites.	5.0–6.5	Full overhead light required.	Ornamental; wood is useful for general farm repairs.	Has suffered from bronze borer when planted on prairie.
Grows on relatively dry to normally drained soils of varying texture.	5.0–6.5	Will tolerate a little shade in early life.	Produces strong timber which works well, may be used in cabinet making, suitable for fence posts and farm repairs.	This tree should be more extensively planted.
Native to moist river flats, but when planted thrives on a wide variety of soil conditions.	6.0–7.5	Requires overhead light.	A good shade tree. Wood used in the East for cheese boxes, fruit baskets, barrels, and hockey sticks. In open situations branches may break at the crotch.	This tree adapts itself to a wide range of soils and may be grown almost anywhere in Manitoba, *except on dry sandy soils.*

TABLE NO. 5 (CONT'D)—TREES AND SHRUBS SUITABLE FOR FARM FORESTRY AND TREE

NAME		CHARACTERISTICS OF TREE OR SHRUB			
Common Name	Scientific Name	Habit	Rate of Growth	Average Maximum Height in Feet.	Average Maximum Age at Maturity
Siberian, Manchurian or Dwarf Asiatic Elm	Ulmus pumila L.	A smaller tree, more bushy, and with fine leaves.	Grows a little more rapidly in early years.	30 to 40 ft.	Unknown under Manitoba conditions.
Siberian Crabapple or Siberian Berried Crab	Malus baccata (L) Borkh.	Small tree of spreading habit, attractive for its bloom and red fruit.	Growth medium.	20 to 30 ft.	Long-lived.
Mountain Ash or Rowan Tree	Sorbus americana Marsh.	A small tree of symmetrical shape; red berries persist through the winter.	Medium.	25 ft.	Not ascertained.
Saskatoon	Amelanchier alnifolia Nutt.	A small tree or shrub which forms thickets by suckering.	Medium.	10 to 15 ft.	New shoots from roots replace old stems.
Hawthorn	Crataegus sp.	A thorny shrub with red berries.	Medium.	5 to 12 ft.	Appears to be long-lived.
Siberian Cotoneaster	Cotoneaster spp.	A close, compact shrub, dark green leaves turn red and are retained until late in the fall.	Medium.	5 to 10 ft.	Not known under Manitoba conditions.
Choke Cherry	Prunus virginiana L.	A small tree.	Fairly rapid from seed, occasionally grows from root-suckers.	10 to 15 ft.	
Pin or Red Cherry	Prunus pennsylvanica L.	A small tree.	Fairly rapid growth from root-suckers.	10 to 15 ft.	
Wild Plum	Prunus nigra Ait.	A bushy tree with semi-thorns, masses of attractive bloom early in spring, red fruit.	Medium growth from root-suckers.	10 to 20 ft.	
Caragana or Siberian Pea Tree	Caragana arborescens Lam.	The well known hedge plant, yellow flowers produce pods, pinnate leaves with 8 to 12 leaflets.	A rapid grower.	20 ft. in Red River Valley.	Has been grown here for about 50 years without showing signs of old age.
Caragana or Bushy Caragana	Caragana frutex (L.) Koch.	A smaller caragana. Leaves have 4 leaflets.	A rapid grower.	10 ft.	Not ascertained.
Manitoba Maple or Boxelder	Acer negundo L. (Negundo interius Rydb.)	The common native maple often has a shrub-like habit but with pruning makes a good shade tree with a compact symmetrical crown.	2.5 ft. in 2 years from seed, continued rapid growth for about 20 years.	65 ft. in Red River Valley, 50 ft. on Souris soils, 20 ft. on Waskada and Oxbow soils.	80 years in suitable sites, in drier districts tops die at about 25 years.

CULTURE PROJECTS IN MANITOBA, THEIR CHARACTERISTICS, REQUIREMENTS AND USES

HABITAT REQUIREMENTS				
Moisture and Soil Adaptation	Soil Reaction—Hydrogen Ion Concentration (pH) Under Optimum Conditions. 7.0 is Neutral, Under 7.0 is Acid, Over 7.0 is Alkaline	Light Requirements	Utility	Remarks
Requirements similar to White Elm.	Unknown, but probably similar to Native Elm.	Requires overhead light.	Used in windbreaks. Effective on account of its low branching habits.	Introduced; some of the earlier stock not winter hardy.
Moist to well drained sites.	6.0–7.5	Requires overhead light.	Ornamental when in flower; fruits profusely.	Nursery men have made selections from this species, and it is also used for grafting stock.
Moist to well drained sites.	4.5–5.5	Will stand considerable shade.	Ornamental; berries attract birds.	Does best when planted on a northerly exposure, or with some shelter on south side.
Normal drainage.	5.0–6.0	Full light required.	One of our best wild fruits.	Selections with white fruit have been made.
Normal drainage.	6.0–7.5	Full light.	Ornamental red fruit, can be used for hedges.	Many species, two of which appear to be native to Manitoba.
Normal drainage.	6.0–8.0	Full light.	Ornamental, valuable for hedges, berries hang on through the winter.	Quite hardy and adaptable to different soils.
Normally drained sites.	6.0–8.0	Full light.	Berries attract birds, often mixed with other fruits in preserving.	Adaptable to different soils.
Normally drained site required. Grows well on medium to light textured soil classes.	5.0–6.0	Full light.	Flowers very ornamental in early spring. Red fruit valuable for preserving.	Tends to form thickets.
Normal to relatively dry sites.	6.0–8.0	Full light.	Useful for fruit, ornamental.	The two wild plums are variable and difficult to separate, possibly due to hybridization.
Relatively dry to moderately well drained sites; cannot tolerate wet conditions.	6.0–7.0	Full light required.	A useful shrub for hedges and windbreaks.	Introduced from southern Russia.
Cannot tolerate wet conditions.	6.0–7.0	Full light required.	Ornamental and used for hedges.	Native of southern Russia and Siberia.
Fairly drought resistant. Will grow on most Manitoba soils. Native to river terrace and flood plains.	6.0–8.0	Moderate light required.	Extensively used in the past for windbreaks; may be used for firewood.	Desirable to replace this tree in many cases, by other trees of longer life and less affected by canker worm.

Table No. 5 (Cont'd)—Trees and Shrubs Suitable for Farm Forestry and Tree

Name		Characteristics of Tree or Shrub			
Common Name	Scientific Name	Habit	Rate of Growth	Average Maximum Height in Feet	Average Maximum Age at Maturity
Basswood or Linden	Tilia glabra Vent. (Tilia americana L.)	A native of southeast Manitoba. A good shade tree, with large heart-shaped leaves. Flowers in middle of summer.	About the same as Manitoba Maple in early years.	50 to 65 ft.	120 years.
Buffalo Berry	Shepherdia argentea Nutt.	A shrub with silvery foliage, in fall covered with bright red edible berries.	Medium.	15 ft.	
Russian Olive	Elaeagnus angustifolia L.	Similar to above, but fruit is silvery and hard.	Medium.	10 to 20 ft.	Not known under Manitoba conditions.
Red Osier Dogwood	Cornus stolonifera Michx. (Svida stolonifera Rydb.)	Native shrub of spreading habit, stems bright red.		6 ft.	New shoots from root replace the old.
Green Ash	Fraxinus pennsylvanica lanceolata (Borkh). Sarg. Var. (Fraxinus lanceolata Borkh.)	A straight boled tree with a narrow crown, coarse twigs, leaves turn yellow early in fall.	Fair growth when planted singly; diameter growth is slow in plantations unless spacing is wide.	65 ft. in Red River Valley.	120 years.
Common Lilac	Syringa vulgaris L.	Upright shrub, which suckers profusely, fragrant lilac flowers, dark green leaves remain very late in the fall.		10 ft.	New shoots from root replace the old.
Villosa Lilac or Chinese Lilac	Syringa villosa Vahl.	Similar to above but has pink flowers and does not sucker.		10 ft.	
Tatarian Honeysuckle	Lonicera tatarica L.	Upright shrub of compact form; produces a mass of pink flowers.		10 to 15 ft.	New shoots from root continuously replace old; bushes over 50 years old are known.
High Bush Cranberry	Viburnum trilobum Marsh. (V. opulus L.)	Native of river flats, a few stemmed shrub, with broad white flowers and red edible fruit.		5 to 10 ft.	New shoots from root replace old.

CULTURE PROJECTS IN MANITOBA, THEIR CHARACTERISTICS, REQUIREMENTS AND USES

HABITAT REQUIREMENTS				
Moisture and Soil Adaptation	Soil Reaction—Hydrogen Ion Concentration (pH) Under Optimum Conditions. 7.0 is Neutral. Under 7.0 is Acid. Over 7.0 is Alkaline	Light Requirements	Utility	Remarks
Moist to normal drainage; native to river terrace and flood plains of Red River, etc.	6.0–7.5	Will stand slight shade.	Extensively used in the east for furniture, cooperage, boxes, etc.	Not recommended for dry areas.
Grows naturally on well drained to relatively dry sites.	6.0–8.0	Full light required.	Ornamental; fruit may be used for jelly.	A native shrub, will tolerate moderately alkaline soils.
Relatively dry to normal sites.	Will tolerate moderately acid or alkaline soils.	Full light required.	Ornamental.	Introduced.
Moist to normal sites.	6.0–7.0	Will stand considerable shade.	Ornamental.	Red stems are attractive in winter.
Native in moist river valleys, but once established seems to grow on almost any non-saline soil in Manitoba.	6.0–7.5	Requires full light, and for this reason wide spacing is best for woodlot planting.	Shelterbelt (best planted with other trees of more branching habit). Wood is useful for farm repairs, and is an excellent firewood.	The dry years of the period of 1929-39 proved this to be one of the most drought resistant trees.
Normal drainage.	6.0–7.5	Full light required.	Ornamental. Hedges and shelterbelts.	One of the most widely grown shrubs; a native of southeastern Europe.
Normal drainage.	Adapts itself to all soils from slightly acid to slightly alkaline.	Full light required.	Same as common lilac.	Recommended because of its non-suckering habit; introduced from north China.
Normal drainage.	6.0–8.0	Full light required.	Ornamental.	Very hard.
Moist but well drained sites.	6.5–7.5	Will tolerate considerable shade.	Ornamental and fruit.	Could be used to give variety in hedges and ornamental plantings.

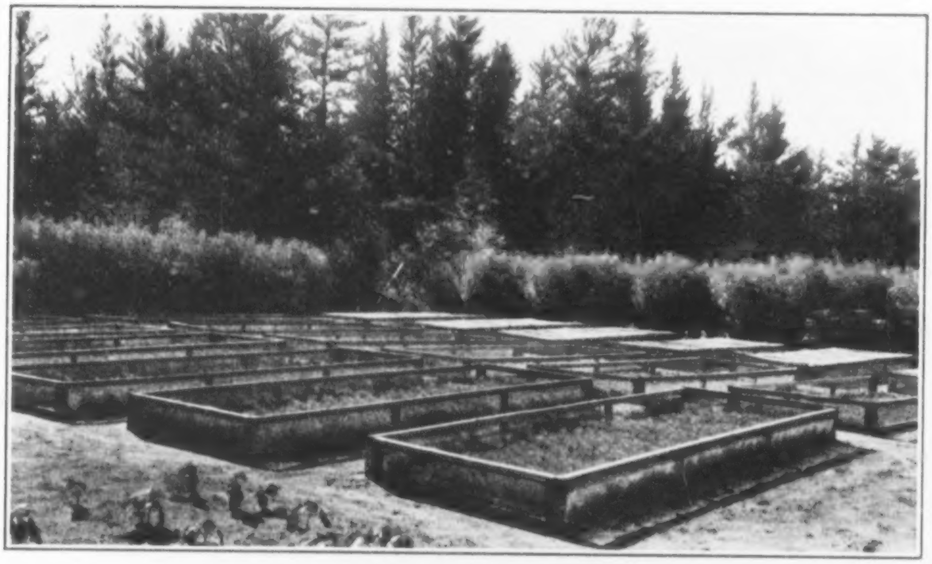

ILLUSTRATION No. 29

Coniferous seedlings started in seed beds in one of the provincial forest nurseries. Seedlings remain two years in seed bed. They are then set out in nursery rows as transplants. Each of the beds shown provides an average of seven thousand seedlings.

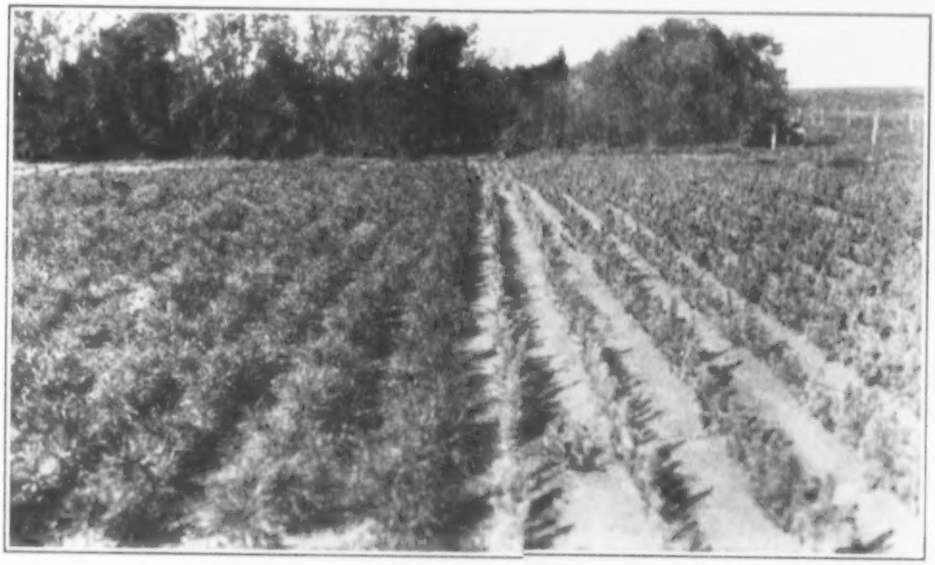

ILLUSTRATION No. 30

Pine and spruce transplant beds in the provincial forest nursery, Shilo (1935). The coniferous transplants usually remain in nursery rows for two seasons. They are then ready to be set out in permanent plantations. Plants grown two years in seed bed and two years as transplants are designated as 2:2.

ILLUSTRATION No. 31

Part of coniferous transplant beds in the provincial forest nursery, Shilo (1935), with windmill, water tower and tool shed in close proximity.

ILLUSTRATION No. 32

Young conifers planted in permanent location by Provincial Forest Service. The young stock from the nursery rows was planted by hand with aid of a planting tool in bottom of furrows which were cut without any previous cultivation by a specially equipped tractor plow.

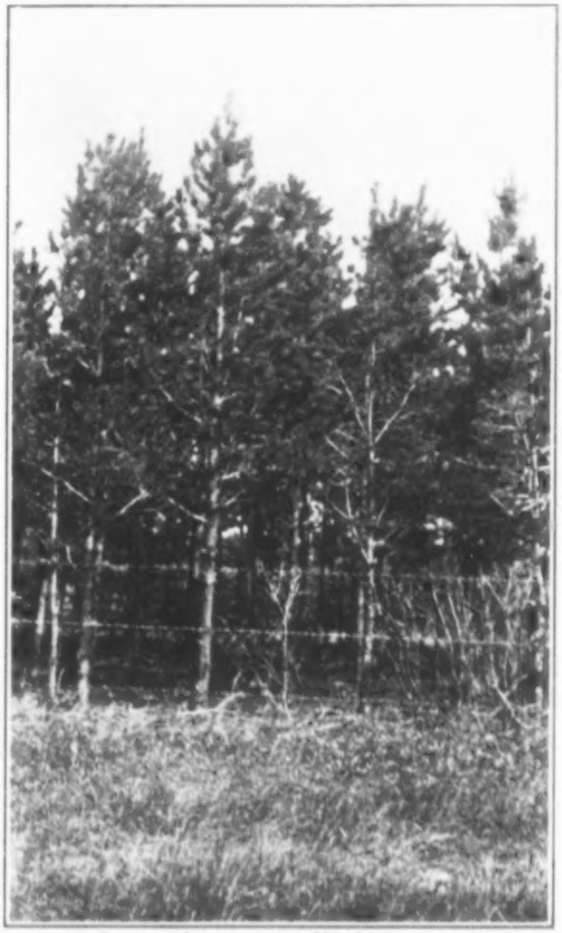

ILLUSTRATION No. 33

Plantations of lodgepole pine at Shilo (1935). A good example of how the grass covered dune sand in the foreground can be converted rapidly into forest if suitable species and afforestation practices are used.

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Plantation of jack pine on dune sand in the Spruce Woods Reserve. Planted as shown in Illustration No. 32.

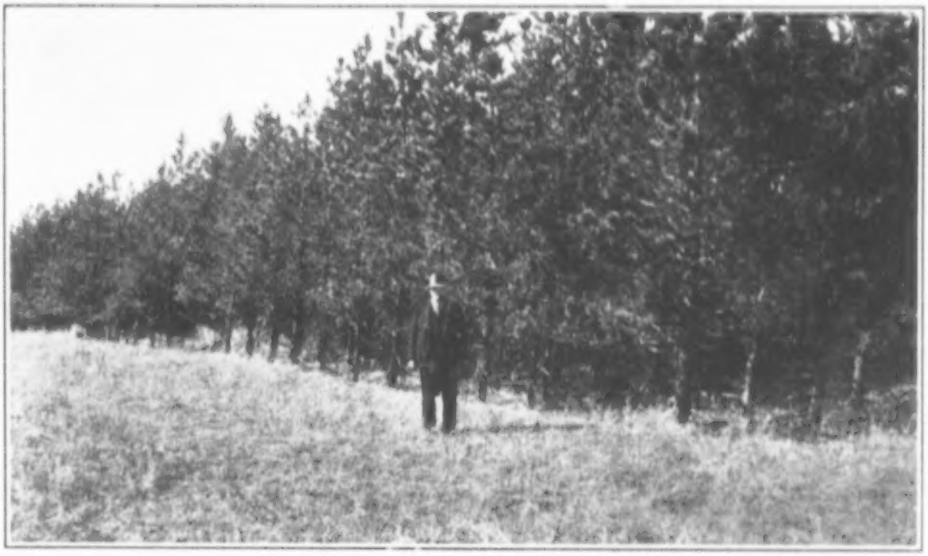

ILLUSTRATION No. 34

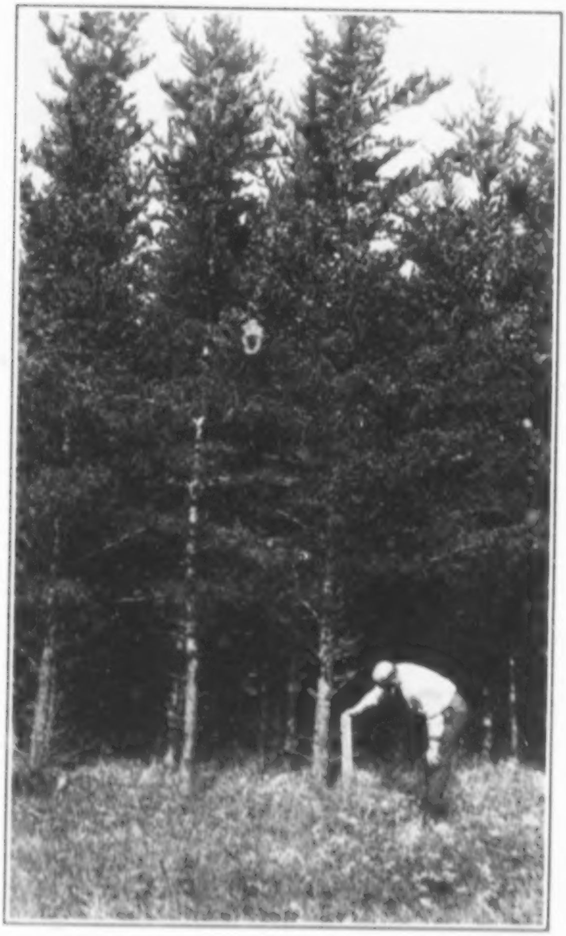

ILLUSTRATION No. 35

Pine plantation on dune sand in the Spruce Woods Reserve (1944), planted as shown in Illustration No. 32. The straight growth and the natural pruning of the lower limbs is the result of close planting. (See Illustration No. 36.) This plantation is now too crowded and thinning is required.

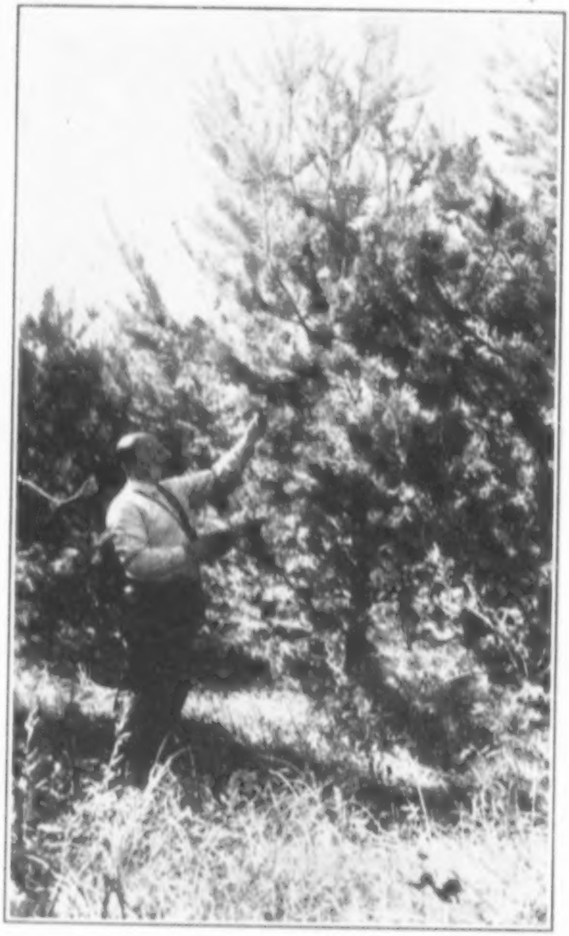

ILLUSTRATION No. 36

Pine on dune sand in the Spruce Woods Forest Reserve (1944), showing the bushy form that gives an undesirable timber type that results when the trees are not sufficiently crowded.

ILLUSTRATION No. 37

Harvest from Manitoba woodlots provides fuel and revenue.

⁂

Manitoba woodlots provide revenue. Aspen poplar and jack pine being cured preparatory for the manufacture of boxes.

ILLUSTRATION No. 38

ILLUSTRATION No. 39

Spruce planted by Forest Service on Turtle Mountain, southwestern Manitoba. This plantation was set out in 1912 and was badly eaten by rabbits, but recovered, and appeared as above in 1940.

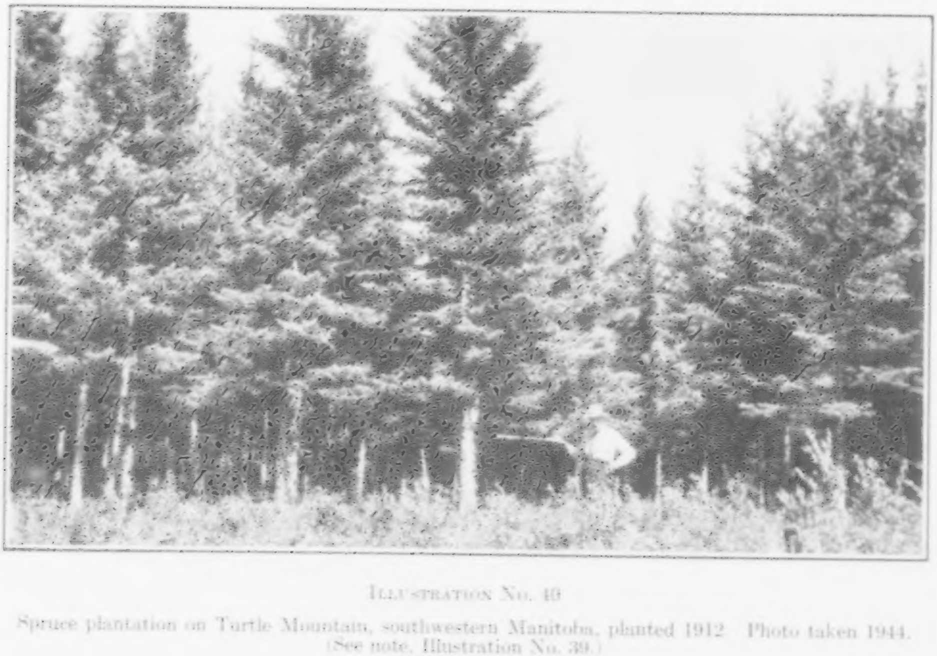

ILLUSTRATION No. 40

Spruce plantation on Turtle Mountain, southwestern Manitoba, planted 1912. Photo taken 1944. (See note, Illustration No. 39.)

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ILLUSTRATION No. 41

Spruce at left, Scots pine at right, planted on Turtle Mountain, southwestern Manitoba by Forest Service. Photo taken 1940.

* * *

Scots pine on Turtle Mountain, southwestern Manitoba, planted 1912 by Forest Service. Photo taken 1944.

ILLUSTRATION No. 42

VIII. WOODLOT PROJECTS

It has been shown in Sections IV and VI that there are local areas, scattered throughout the prairie and aspen grove region, which are not suitable for arable culture. Some of these areas are quite suitable for the production of trees. In some cases these areas are already wooded, so that the native trees are, or can be, used as natural woodlots. In other cases, afforestation by planting or seeding would have to be undertaken if woodlots are to be established. In either case the farm owner should aim to use the whole of his farm to the best advantage. Although it does not necessarily follow, that all land not suited for agriculture is suitable for the production of trees, nevertheless on soils of low agricultural value, where trees can be grown, the importance of establishing and maintaining farm woodlots as an improved land utilization measure should be given full consideration.

In general a woodlot is an asset to any farm so long as it is not located on land that could be better used for other purposes. While the main value of a woodlot may lie in the production of wood or timber for use on the farm and for sale, there are other values, which are not so obvious, but which may be of considerable importance.

The woodlot and farm forestry projects recommended to meet the conditions found in the prairie-aspen grove region in Manitoba can be outlined and considered under the following headings:

A. Natural woodlots requiring improvement and maintenance (or reforestation projects);

B. Afforestation projects;

C. Community forests;

D. Farm forest co-operatives.

A. Natural woodlots requiring improvement and maintenance:

In the prairie and aspen grove region of Manitoba the natural woods have been grouped into six types. (See Section VI.) The type of growth, the present use, and the future action indicated for each of these six types may be outlined as follows:

(1) Small groves occurring as fringes of poplar and willow around poorly drained non-saline depressions, such as occur in the Oxbow soil area.

(a) *Type of Growth:*

These small groves of woods occupy the slope and intermediately drained portion in the basin-like depressions in the prairie. The vegetation is in concentric rings. Snowberry or waxberry form the upper or outside ring on the drier site next to the prairie grasses and herbs, followed in sequence in the lower portions first by aspen, then by aspen (or sometimes balsam poplar) and willow (Salix spp.), and with shrub willows and swale grasses in the lower more moist portion next to the hydromorphic swale or slough.

(b) *Use:*

These groves of poplar are used chiefly as private woodlots for fuel. Cutting when very immature is a common and wasteful practice. Severe periodic drought is a frequent cause of havoc; the killing back of the trees by drought and damage by borers are responsible for failure of the poplar to reach normal maturity or to develop into any great size. As the native poplar groves are established, however, they trap snow and bring about conditions that are more favorable for the introduction of other trees. In other words, these groves are a pioneer invasion that develops only so far under virgin conditions, but under culture they can be utilized as a nurse crop for other species of utility trees.

(*c*) *Action indicated:*

Removal of dead wood where present;

Thinning, as required, to permit new introductions;

Introduction of new species on selected growth sites to secure mixed stands;

Maintenance of mixed stands for fuel, fence posts and farm repairs;

Protection from stock by fencing;

Protection from grass and stubble fires by use of fire guards;

Controlled cutting of sound trees by harvesting only as trees become mature, or as thinning and improved cutting may be required.

Some utility trees that could be introduced for woodlot improvement:

Site occupied by native species:	*Introduced species indicated:*
Snowberry and aspen	Oak and lodgepole pine.
Aspen	White spruce, Scots pine and green ash.
Aspen and shrub willows	White spruce and tree willows.
Willow and swale grass	Tamarack.

(2) HILLSIDE AND OTHER NATURAL WOODS OF SOMEWHAT RESTRICTED EXTENT, OCCURRING ON FAVORABLE LOCAL SLOPES AND SITES.

(*a*) *Type of Growth:*

These woods may have started as small groves in the intermediately moist non-saline position, but the woods have ascended the northern and eastern slopes of morainic hills and the northern and eastern exposures where the topography is rolling or strongly undulating in boulder till areas, such as the Tiger Hills and Newdale soil associations. The extent of the woods is usually determined by the length of the slopes.

The native vegetation in these hillside woods invariably has the following sequence: snowberry and silverberry occur as a fringe just below the crest, followed at a slightly lower level by oak and hazel, these grade into aspen poplar, which dominates the slopes. Toward the foot of the slopes, balsam poplar and shrub willows prevail. Scattered ash and such shrubs as saskatoon and dogwood are sometimes found, and an occasional birch may mark seepage or springs. Where these woods occur on morainic hills the land is more or less stony.

(*b*) *Use:*

These hillside woods are mostly privately owned, but in some cases they may be on municipal lands. These woods supply fuel, fence posts, etc., and because the woods are more extensive and are under a somewhat more favorable humidity climate, the individual trees here reach a better developed condition than do the trees in the small ring-like groves that occur in the shallow depressions of the prairie.

In far too many cases, however, these woods are used as pasture areas, with resulting injury to natural regeneration.

(*c*) *Action indicated:*

The hillside woods would make excellent private or community woodlots if improved and maintained by the adoption of approved silvicultural or farm forestry practices. Where the woods are to be maintained the following action is recommended:

Fencing, to keep stock from obtaining access;

All dead wood should be removed for fuel—it is a fire hazard and harbors destructive insects and fungi;

A greater variety should be established by the introduction of other species of utility trees which could be used for fuel, fence posts, tools and farm repairs, etc.;

Protection from fire is imperative;

Controlled cutting by harvesting only as trees reach maturity or as thinning or improvement cutting is required should be adopted.

Municipal or community woodlots could be established on municipally owned land, and these could be maintained also as game preserves.

Where the hillside woodlots are more extensive, consideration should be given to the establishment and maintenance of town or city woodlots, both as a means of employment and as a source of fuel.

The utility trees that could be introduced for woodlot improvement are as follows:

Site occupied by:	*Introduced species indicated:*
Oak	Lodgepole pine and Scots pine.
Aspen poplar	White spruce, Scots pine, green ash, elm.
Aspen, balsam poplar and willow	Elm, white spruce, birch.

(3) EXTENSIVE HILLSIDE WOODS (OR FOREST) ON THE RELATIVELY STEEP SLOPES, THE ROUGH TOPOGRAPHY, THE RAVINES, AND THE BENCH LANDS OF THE MANITOBA ESCARPMENT.

(*a*) *Type of growth:*

These woods may be considered as a strip of forest occupying the eastern and northern slopes, the bench lands and the ravines of the Manitoba escarpment. The soils indicate that woods have occupied the escarpment for a long period of time, and under protected conditions trees will grow to normal maturity. In the southern portion of the Pembina Hills section the forest cover is around a township or more wide, but in the northern portion of the Pembina Hills section, in the central or Assiniboine delta section, and in the northern or Riding Mountain section the woods have crept over the escarpment and invaded the upland for greater distances. The higher the altitude of the upland, the farther the woods have encroached on the prairie west of the escarpment.

As may be expected in an area as large as this, favorable growth sites exist for a wide variety of trees. Practically all the deciduous boreal trees and shrubs (as well as sumac) are to be found in the Pembina Hills or southern section. Aspen and balsam poplar dominate in the central section, but on the longer slopes and higher altitudes of the Riding Mountain section, coniferous boreal trees (white spruce and jack pine) and mountain ash are mixed with the broad leaved boreal species.

(*b*) *Use:*

The upper levels of the Riding Mountain section are part of Riding Mountain National Park, but below this, except for the portions that are cleared and cultivated on the bench lands, all the lower slopes and the hilly or rough topography of the central and southern section of the escarpment are potentially private, community or municipal forest lands and woodlots.

In the escarpment generally, conditions are favorable for natural reproduction and growth of forest trees. Saw logs were cut in the early days of settlement and trees for all types of wood products could be produced. Logging, fire and browsing of stock have modified the original stands in much of the area. This area is, and could be, more profitably developed as a valuable source of timber and wood products.

(*c*) *Action indicated:*

I. Where the natural woods or forest are to be utilized as woodlots the following practices are indicated:

Protection from fire is imperative;

All areas retained for woodlots or farm forests should be fenced to protect them from stock. Grazing, browsing and trampling of stock inhibits natural reproduction;

It is advisable that roads and trails be made on the contours to facilitate the work of management;

Improvement cutting and clearing should be followed to remove dead, defective and weed species;

Sound trees should not be harvested until mature. Cutting should not exceed the annual increment, in order to insure sustained yields and permanence of the woodlot.

Where the woods or forest have been destroyed by fire, afforestation with improved species should be practiced where possible in order to avoid inferior types taking possession.

The woods and forests on the escarpment are sufficiently extensive that towns, villages and municipalities may be well advised to obtain, establish and maintain woodlot areas for use as a source of fuel and as a means of providing employment.

II. Where woods are being cleared on the bench lands and the gentle slopes for arable culture, strips of trees and shrubs should be left on the contours as a soil conservation measure and as a check on water erosion. This will insure that the cultivated fields are worked crosswise of the slopes. The wooded strips should be put under management practices as recommended for the general woodlots. The steeper slopes, the hilly topographical areas and the ravines should be retained as woodlots.

(4) WOODS OF THE STEEP SLOPES OF THE DEEP RIVER VALLEYS AND RAVINES WEST OF THE ESCARPMENT.

The deep valleys and ravines west of the escarpment are of two forms. First, the U-shaped valleys with broad and somewhat flattened valley floor, and second, the V-shaped valleys without the broad valley floor.

(*a*) *Type of growth:*

In both the U-shaped and the V-shaped valleys the vegetation on the slopes is similar. The banks which have northern and eastern exposures are generally wooded from crest to the foot of the slope. The banks which face west and south in the western part of the province are generally droughty and covered with dry land grass vegetation.

As the valleys wind eastward, trees gradually take the place of grass at the foot of the slopes and the woods then creep higher and higher up the banks and extend as finger-like intrusions up the contributary ravines until, in the eastern reaches, the woods more or less cover all slopes from crest to foot, regardless of exposure.

The sequence of trees is very much the same on both areas—oak occupies the highest position, aspen and poplar dominate the slopes, but ash may be scattered throughout, and oak marks the drier sites and outcrops of shale. Occasionally birch may be found in positions made moist by springs and seepage. As the deep valleys and ravines west of the escarpment are invariably cut into shale, the trees on the middle and lower slopes are generally on very shallow soil and weathered shale. However, the roots extend through the weathered shale and downward through fissures in the rock. At the foot of the slopes and especially on the fertile soils and flood plains of the broad U-shaped valleys, maple, elm, balsam poplar and tree willows occur along with aspen and birch.

(*b*) *Use:*

The woods of these deep valleys and ravines have been an extensive source of fuel, fence posts, poles, and (in the early days) logs for buildings. As these valleys wind through the prairie region they are excellent sources of wood for the farms and villages on the adjacent upland prairie. The wooded slopes should be maintained as private, community and municipal woodlots for the production of fuel.

The fertile soils of the flood plains that are well drained in the broad U-shaped valleys are agricultural lands. However, where shale and non-arable soils occur on the valley floor they should be used for farm forestry. A wider variety of valuable forest trees can be grown on the valley floor and the flood plains than can be produced on the shaly slopes. In addition, the wooded valleys would make an ideal setting for scenic highways.

(c) *Action indicated*

The trees in the deep valleys and ravines are all broad leaved species. Conifers do not occur naturally because of the absence of mother trees. Useful coniferous forest trees such as lodgepole and Scots pine and white spruce, etc., should be introduced to provide mother trees on the slopes. White spruce and tamarack would be valuable introductions on the valley floor.

The woods should be protected from damage by fire and stock.

Roads or trails should be made on the contour at the necessary intervals to facilitate the work of management.

Dead, defective and weed species should be removed.

Where the stands are too thin, or the stand has been destroyed by fire, by stock, or by excessive cutting, afforestation should be followed to insure an adequate stand of utility trees.

Cutting should be controlled so that except for improvement cuttings, clearing and necessary thinning, cutting will not exceed the annual increment to insure sustained yield and permanence.

(5) WOODS ON RIVER TERRACES, FLOOD PLAINS, AND AS A FRINGE ALONG THE BANKS OF SHALLOW STREAM CHANNELS EAST OF THE ESCARPMENT.

(a) *Type of growth*

These woods constitute ribbon-like strips of deciduous trees that mark the course of the streams on the so called first prairie steppe. On the immature soils of the river terraces, in the shallow channels, and on the alluvial flood plains where the streams may periodically overflow their banks, shrub willows, Manitoba maple, elm, basswood, ash, balsam poplar and cottonwood are dominant and make exceptionally good growth and reach maturity.

The woods on the flood plains and the well drained sites on the crest of the abrupt river banks are fringed with oak.

(b) *Use:*

The soils on the river terraces and flood plains are exceptionally fertile, and some portions have been cleared and used for market garden purposes. Where the land is surveyed into river lots, the wooded fringe is used as building and home sites. Portions of the woods in too many cases have been used as pasture, with resulting destruction of the natural seedlings.

Although the area involved on most farms where these woods occur is relatively small, it could be made a valuable source of good quality timber. Because of the high value of the soils for horticultural crops and agricultural use it is doubtful if the woods will be retained generally for farm forestry. It is suggested however, that in addition to home sites, portions could be selected and maintained as picnic parks at points where they are adjacent to main highways. Where clearing is followed and soils used for arable culture, trees should be left along fence margins for the production of timber, for field protection, and as suitable harbors for birds and wild life.

(c) *Action indicated:*

It is highly important that steps be taken to guard against wholesale and excessive clearing of these valuable tree sites.

Good species of deciduous trees are present in virgin stands, but many stands are being injured. Where strips of woods are left for field protection or where the native woods are used for farmstead shelterbelts, coniferous trees should be introduced to give variety and scenic effect.

Except where large trees are left to provide shade trees in paddocks and pasture fields, these woods should be fenced to prevent stock from inhibiting natural reproduction and damaging growing trees.

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Dead, defective and weed species should be removed, and the thickness of the stand in the farm woodlots should be regulated by such improvement cuttings as may be required.

On these growth sites, good species of hardwoods will grow to maximum maturity and produce large sized trees and valuable timber. Hence, premature cutting or cutting before the trees have reached their maximum value should be avoided.

The growing of trees in boundary strips provides an opportunity to develop outstandingly good tree specimens by judicious pruning and suitable care.

Provisions should be made for regeneration and replacement wherever aged stands occur.

(6) WOODED AREAS FORMED AS THE RESULT OF WOODLAND INVASION OF PRAIRIE.

(*a*) *Type of growth:*

This type of wooded growth occurs on the degrading blackearth and grey-black soils in the more humid districts of the eastern and northern prairies. They are generally adjacent to more heavily wooded areas.

The woods are composed chiefly of aspen and balsam poplar; they are usually in the form of large groves of straight, well shaped immature trees. Oak may occur occasionally in association with aspen on the drier sites, and oak with hazel becomes the dominant growth on the mounds where weathered shale rock outcrops, or is only thinly covered with soil. These groves are intermixed in the normal and intermediate positions with tall prairie grasses and herbs. They are found chiefly in the Altamont, Indian Springs, Manitou, Darlingford, and Pembina soil associations west of the Pembina Hills section of the escarpment; they also occur on the Firdale soils of the Assiniboine delta, and in the northern portion of the Newdale soil association where the northern blackearths merge into the grey-wooded soils of the Riding Mountain. Large poplar groves containing more balsam poplar and willow are also found on the smooth sandy textured terrain where the Almasippi soils are characterized by moist substrata.

(*b*) *Use:*

These large aspen poplar groves are used locally for the production of fuel and poles.

As the aspen reproduces readily from suckers, and as the moisture conditions are good, these groves reproduce readily even after cutting or fire. However, due to prairie fires prior to settlement and to the practice of premature cutting, the trees have not been permitted to reach full maturity. These woods, to a large extent, occupy land that has agricultural possibilities; fields which formerly contained large groves of aspen have been cleared and put under arable culture. Doubtless other portions will be cleared and put to agricultural use. Where clearing is undertaken in the future, sufficient acreage should be left as woodlots to supply the local and farm fuel needs. Moreover, advantage should be taken of the natural tree growth by leaving unbroken tree strips through the fields to provide (insofar as the growth will permit) for field shelterbelts. This practice would reduce the amount of field shelterbelt plantings that may have to be undertaken to protect the soil from drifting. The strips of woods thus left in clearing could be extended by the planting of cultivated tree and shrub hedges as required to give continuous shelterbelts around all fields.

(*c*) *Action indicated:*

Areas of large poplar groves left as woodlots should be fenced and protected from livestock. Other utility trees such as white spruce, elm and ash should be introduced to give greater variety. Narrow strips of native poplar tend to be short lived, hence other and longer lived utility trees should be introduced with such strips as required.

Care should be taken to insure that fires do not run into the treed strips (or into the woodlots) from the burning of adjacent grass and stubble.

The woodlots and field strips should be kept healthy by the removal of dead, damaged, and diseased trees.

Premature cutting of sound trees results in lower yield; controlled cutting is advisable, and cutting of sound trees should be delayed till maximum returns can be obtained.

General:

In order to foster the conservation and preservation of the natural woods in the prairie-aspen grove region for woodlots or farm forestry; to insure that such woods will be utilized to obtain maximum production; and to hasten the adoption of silvicultural practices that are best suited to each of the local conditions described, a vigorous policy of demonstration, education and assistance is required.

It is recommended (1) that representative blocks of each of the six types of natural woods be obtained and set aside as farm forest demonstration areas; also (2) that full time workers trained in forestry and silviculture should be appointed and attached to the appropriate department of government or to the University, whose duties would be:

(a) To demonstrate in a practical way the most suitable and profitable silvicultural practices for each of the different types of natural woodlots set aside as demonstration areas;

(b) To plan and put into operation such educational programs in respect to farm forestry as may be necessary throughout the agricultural portion of the province;

(c) To establish farm demonstration woodlots with co-operative farmers, and

(d) To act as advisors in farm forest management or tree culture projects. The services of such technically trained personnel should be available to provincial and municipal government officials, to farmers, and all other land owners, etc., who may require advice or assistance in establishing, improving, and maintaining farm woodlots, or in marketing farm woodlot products.

B. Afforestation Projects:

The areas which are recommended as suitable for afforestation are outlined on page 57 as:

(a) Afforestation of Souris sands and dunes in the Lake Souris Basin;

(b) Afforestation of sands and dunes of the upper Assiniboine Delta;

(c) Afforestation of sands and dunes of the lower Assiniboine Delta.

(a) Afforestation of Souris sands and dunes in the Lake Souris Basin:

The light textured soils of the Souris basin are a complex of soil types. Dune sands occur under stunted and scattered oak, aspen, ground juniper, artemisia and cactus, and sparse bunch types of grasses. The dune sands with their sparse vegetation are interspersed with smoother areas of Souris sand and loamy sand, the flatter portions of which have a moist substratum and support thick immature stands of balsam poplar, aspen poplar and shrub willows. In addition to the wooded areas there are areas of the poorly drained Souris sand that are under meadow grasses. These areas are used as native hay lands. The land which is primarily suitable for afforestation is the duned portion, but because the unproductive dunes are interspersed with light soils that are producing some fuel, or which are being used for hay and pasture, and because such a large proportion of the land is under private ownership, the development of an afforestation program presents a number of difficulties.

Afforestation of these dunes could be established by a number of methods, or by a combination of methods. If a Provincial Forest Reserve were established as a block that took in all the dunes that required afforestation, a considerable portion of the wet sands under native tree vegetation would be included, as well as some of the meadow areas. An alternative to the establishment of a forest reserve would be to develop the area under private or municipal control for different uses. In other words, as an alternative to establishing a solid block for forestry purposes under government control, consideration should be given to the afforestation of the dunes, the improvement of the native woods, and the utilization of the hay and pasture areas under individual or community enterprise.

The problem of the best utilization of this area may be implied from the following summary of the acreages involved. The area of the soils of the Souris Association is approximately 635,000 acres. Of this, approximately 305,000 acres are arable farm land. Of the remainder, approximately 81,000 acres are dune sands, 134,000 acres are sands which are too light for successful arable culture, and 115,000 acres are hydromorphic or wet sands. It is the irregular intermixture of the last three mentioned conditions here that is responsible for the complexity of the forestry and land utilization program. The land use policy will have to be determined before recommendations can be made, but it is estimated that in addition to the 81,000 acres of dunes a further 67,000 acres of light soils are more suited for afforestation than for any other purpose. A more detailed study of the present land use and land ownership should be undertaken, but it may be tentatively estimated that there are 148,000 acres of land in this area unsuitable for agriculture or for grazing, which could be used for afforestation purposes.

The only native trees that occur in the duned area of the Souris basin are broad leaved species (i.e., oak and poplar). Neither these species nor the native grasses thrive under the light soil conditions that prevail. Consequently, little or no value in the form of wood or pasture is obtained from the duned and light sand areas.

Despite the fact that the broad leaved trees do not thrive on the duned and light sandy areas, nevertheless such areas will produce coniferous trees successfully if they are introduced under careful management. This has been demonstrated by the Forest Service. It is recommended that such coniferous species as Scots pine, lodgepole pine and white spruce be introduced by an afforestation system of planting, similar to that undertaken in the coniferous plantations in the Spruce Woods Forest Reserve.

The comparatively moist sites between the dunes which produce native growths of poplar also could be improved by the introduction of such utility trees as green ash, elm and white spruce. The Souris sands with moist substrata provide good growth sites for a number of tree species that are not present naturally because of the absence of mother trees.

(b) *Afforestation of Sands and Dunes of the Upper Assiniboine Delta:*

The dunes and light sands of the upper Assiniboine delta occupy some 375,000 acres. At the present time 105,000 acres are included in the Spruce Woods Forest Reserve. A considerable portion of the duned area outside the Reserve is held by the Provincial Government or by the respective local municipalities. The duned areas associated with the light Stockton Sands are naturally covered with sparse grass, artemisia, juniper and ground cedar, with scrubby, unthrifty oak and aspen, and with white spruce in clumps or as individual trees, some of which are of considerable size. The dunes and light Stockton sands are unsuitable for the production of arable crops and are of low value for pasture purposes. Their suitability for the production of pine and white spruce has been clearly demonstrated by the successful plantings made by the Forest Service at Shilo.

Because of the unsuitability of the dunes and light Stockton sands for agricultural use; and because of their ability to produce coniferous forests; together with the fact that much of the area outside the reserve is held by the province or by the local municipalities; it is only logical to recommend that the boundaries of the Spruce Woods Reserve be extended to include such portions of the dunes and light sands that lie contiguous to the present reserve. The program of administration and afforestation would then be automatically under the Provincial Forest Service. The remainder of the duned portions in the upper Assiniboine delta that is not adjacent to the reserve could be developed as private or municipal afforestation projects.

It is estimated that 270,000 acres of dunes and light sands, suitable for the production of coniferous forests occur in the upper Assiniboine delta, outside the boundaries of the present Forest Reserve.

(c) *Afforestation of Sands and Dunes of the Lower Assiniboine Delta:*

The duned portion of the lower Assiniboine delta is limited to approximately 46,000 acres. These dunes are unsuitable for arable agricultural use, and although deciduous trees occur on the adjacent Almasippi sands, coniferous trees are absent. The deciduous trees that do occur on the dunes are unsuitable for the growth site and produce unsatisfactory growth. They should be replaced by pines and white spruce.

The relatively moist sites between the dunes are suitable for the production of poplars and the associated shrubs that occur naturally, and also for other broad leaved species which could be introduced. The greater portion of this duned area in the lower Assiniboine delta is held by local municipalities, therefore it would appear logical to recommend that these areas be developed as municipal or community woodlots. As alternatives, they could be developed as provincial or as individual woodlots. To develop such areas as woodlots it is first necessary to undertake an afforestation program in order to introduce coniferous trees such as Scots pine, lodgepole pine and white spruce, which will thrive on the drier sites and to introduce white spruce, tamarack, ash and elm in the poplar woods on the moist sites and smooth areas of the Almasippi sands associated with the dunes.

(*d*) *General*:

It may be noted that the areas for which afforestation is recommended in the prairie aspen-grove region are all light textured soils that are more or less duned. Furthermore, the native vegetation in the duned portions is quite similar except that in the upper Assiniboine delta, white spruce is scattered over parts of the area. With this exception, coniferous trees (which are most suitable for the growth site conditions) are absent. The broad leaved trees that occur in common are dwarfed, misshapen, and unsuited to the growth site.

Although aspen and balsam poplar may occur as a thick stand on the relatively moist non-duned sands adjacent and interspersed between the dunes, such trees cannot adapt themselves to the adverse conditions of the dunes and dry sands. Consequently, if forests are to be established under these conditions, tree species which are suitable for the conditions must be introduced. This means that the program required is one of afforestation or the establishment of forests by the planting of suitable trees.

A sound afforestation program for the above conditions would involve the following steps:

1. The administrative policy must be determined. (The projects could be carried out as a provincial enterprise, or as municipal, community or individual enterprises, with provincial co-operation and direction.)

2. Adequate nursery facilities would have to be established to provide the planting material necessary for afforestation of the various areas.

3. The boundaries of each afforestation property should be delineated and the land control definitely established.

4. The respective afforestation areas should be fenced to protect them from stock, and adequate provision should be made to protect the areas from injury by fire.

5. Where necessary, clearing of dead and scrubby growths could be undertaken.

6. The planting of seedlings or transplants of desirable and suitable trees should be undertaken in season under the supervision of technically trained personnel.

7. An adequate staff of foresters with the necessary assistants should be maintained and given adequate support to insure that the forest plantations would be properly cared for under approved forest management practices.

C. Community Forests:

It is of interest to record that both in Canada and the United States various areas have been set aside for the development of community forests. Locally they may be known as city, town, village, municipal, county, school, hospital, church, memorial, or watershed forests. They may serve one or more of several forestry purposes. Frequently they have been used to protect watersheds and prevent soil erosion. Growing a timber crop is usually an ultimate objective. Often the management plan includes a multiple-use program. In some cases school forests serve as a basis of instruction in forestry methods and for the study of plant and wild life.

The subject of community forests is fully dealt with in the bulletin "Community Forests," United States Forest Service, U.S.D.A. 1937; and in a "Study on Farm Forestry in the Eastern United States," by Joshua A. Cope, Extension Forester, Cornell University, Ithaca, N.Y. The provisions made by the Province of Ontario to foster community forests are outlined in Appendix 6 (e).

D. Farm Forest Co-operatives:

Co-operative management of woodlots and the marketing of woodlot products have been worked out successfully in the states of New York, New Hampshire, Wisconsin, and Minnesota.

Recently (1941) a farm forestry project was initiated by United States Soil Conservation Service to include five townships under wooded vegetation on the North Dakota side of Turtle Mountain. In addition to an all-round conservation program, a farmers' organization known as the Turtle Mountain Woodland Association was formed for the purpose of marketing farm woodland products as lumber, graded fuelwood, and treated fence posts.

Woodland co-operatives permit the employment of technically trained supervisors who direct the management of the woodlot areas. These co-operatives tend to a more efficient handling of the woodland area and toward greater uniformity in the forest products. Further details may be obtained in the following publications:

(a) "Co-operative Management and Marketing for the Woodland Owner." U.S.D.A. Farmers' Bulletin No. 1927.

(b) "Study on Farm Forestry in the Eastern United States," by Joshua A. Cope, Extension Forester, Cornell University, Ithaca, N.Y.

(c) "Marketing of Farm Woodland Products," New Hampshire Bulletin No. 318.

(d) "Co-operation in Forestry," by I. Kissin, Technical Communication No. 2, Imperial Forestry Bureau, Oxford University.

(e) "Soil Conservation," Soil Conservation Service, U.S.D.A., July 1944, pp. 13-15.

The co-operative management of woodlots and the co-operative marketing of farm forest and woodlot products under Manitoba conditions is worthy of more extensive study. (See duties of Farm Forest Unit or Branch. Pages 105-106.)

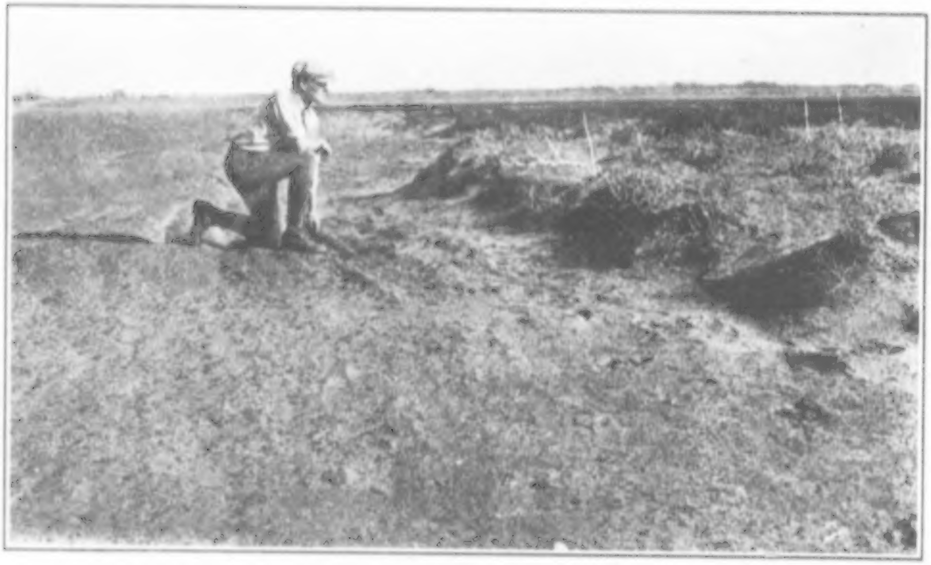


ILLUSTRATION No. 43

View of the flat topography and the open exposed condition of a sandy plain in the Souris basin. Surface soil has been removed from foreground by wind, and sand (from which finely divided matter and clay have been removed as dust) deposited in growth of Russian thistles. This soil has ground water or a moist substrata that will support trees.

ILLUSTRATION No. 44

A forty acre field at Denbow in the Souris basin on the same soil association as Illustration No. 43, but protected by a field shelterbelt. The improvement over the previous scene obtained by planting a tree hedge is striking. However, the light which can be seen through the shelterbelt at the end of the field shows that a row of willow or close growing shrubs is required in addition to make a compact field shelterbelt.

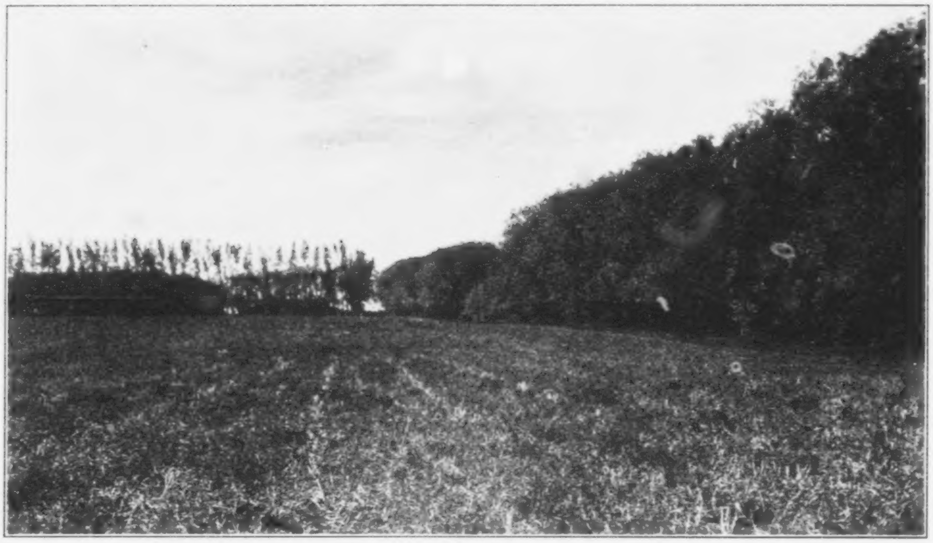
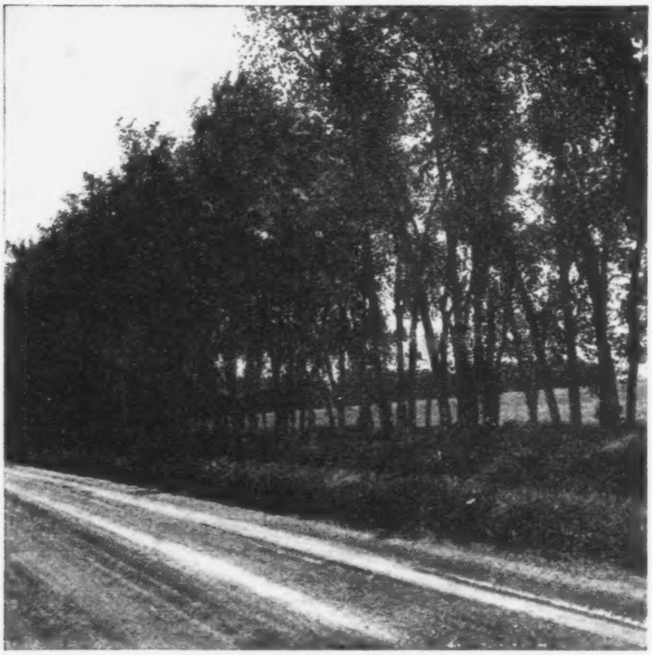


Illustration No. 45

Field shelterbelts at Denbow in the Souris basin. The cottonwoods at the left are of good height (approximately 85 feet) but are too open. The closer and more compact growth of willows is shown in centre and a rough condition of Manitoba maples is shown at right. A row of willow and of caragana with either the cottonwood or Manitoba maple would have made a more effective field shelterbelt.



This row of cottonwoods indicate the good growth made by this tree species in the black earth soils of Manitoba. However, it is obvious that as a field shelterbelt, it is far too open to provide adequate ground cover if planted alone, and that field shelterbelts should not be planted as close to a highway as is here illustrated.

Illustration No. 46

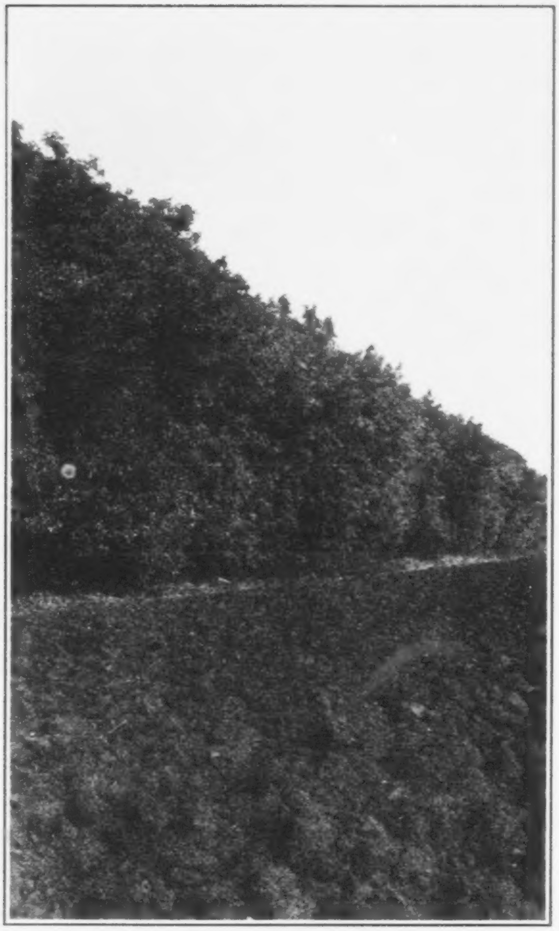


ILLUSTRATION No. 47

A field shelterbelt of three rows of Manitoba maple, on a good growth site. The good field hedge illustrated here is due to the fact that the trees are young, close planted on a good growth site, and have not been injured by stock.

Illustration No. 48

Field shelterbelt of Manitoba maple supplemented and reinforced on the west side with an outer row of caragana, on Carroll fine loam near Hartney (1940). (See Illustration No. 49.)

Illustration No. 49

Scene on east side of field shelterbelt shown as Illustration No. 48. Farmstead shelterbelt around farm buildings is shown at right. In the centre potatoes have been planted to utilize the moisture of trapped snow.

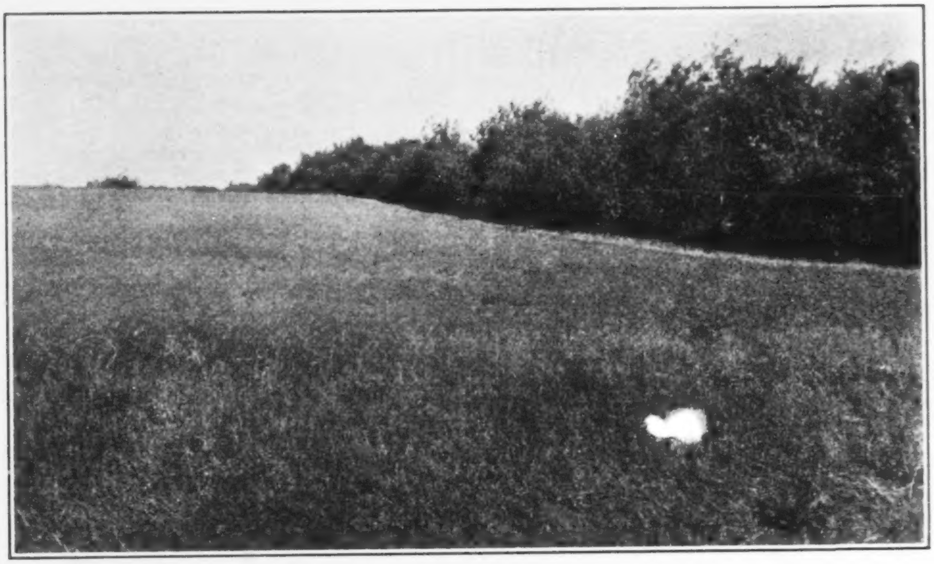


Illustration No. 50

View in Pembina Hills area showing complete removal of tree growth at left (with resulting acceleration of run-off), and the retention of native woods at right. On such slopes, clearing and breaking should be done on the contour, and not up and down hill. Buffer strips of native bush should be retained crosswise of the slope at intervals close enough to check run-off and protect the soil from erosion.

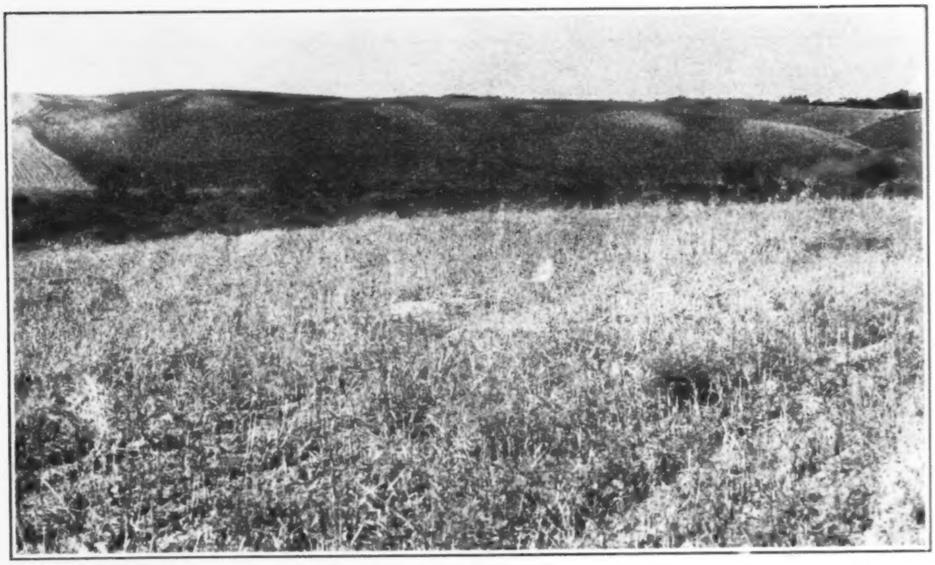


Illustration No. 51

Example of excessive clearing in the Assiniboine section of the Manitoba escarpment, and of the subsequent soil erosion by wind and water. This area was formerly covered with woods. Now the surface soil has been completely removed in a number of places. Buffer strips of trees and shrubs should be planted as field shelterbelts in contour strips to insure narrow fields crosswise of slopes. The building up of eroded portions with manure and a periodic seeding to grass and legumes is also essential as a conservation measure.

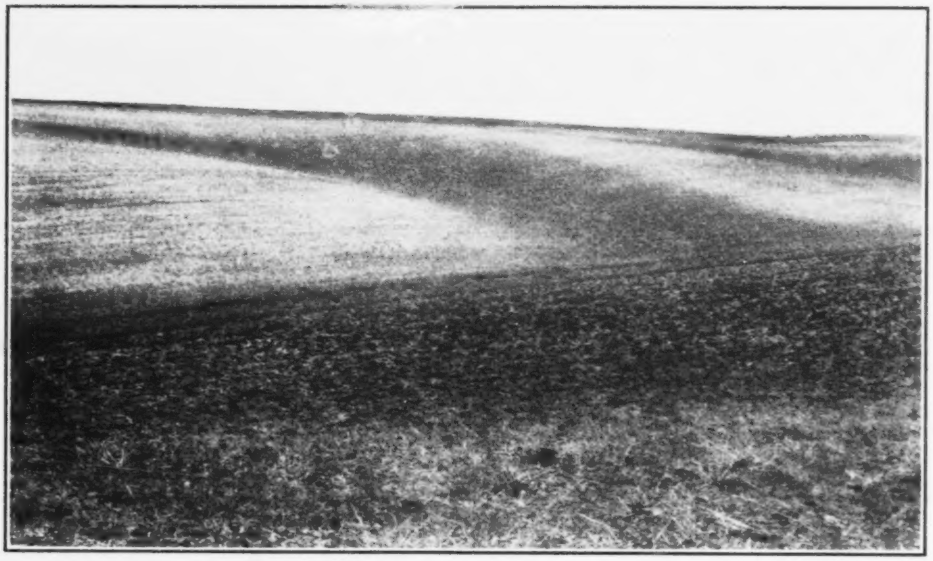


ILLUSTRATION No. 52

Sheet erosion on Carroll silt loam in the Alexander district as the result of exposure to wind and water.

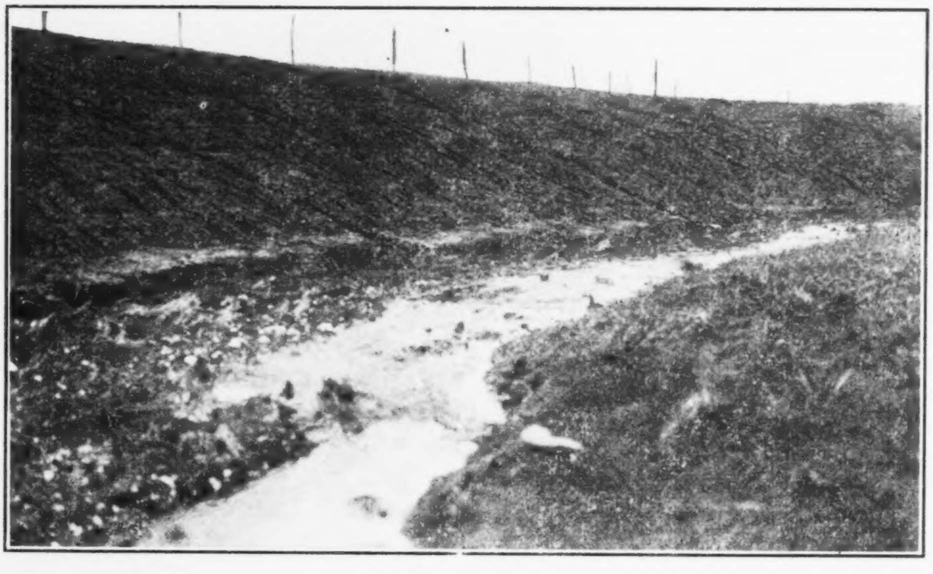


ILLUSTRATION No. 53

Shoestring gullies on a slope feeding into an eroding draw in a summerfallow field in south central Manitoba. The sowing of perennial crops to insure surface cover or the planting of trees for woodlot purposes here would control water erosion. Such sites are too steep for continued bare fallow and grain culture.

IX. FIELD SHELTERBELT PROJECTS

In certain portions of Manitoba there is a definite need for the protection of soil from wind and water erosion, and for the protection of crop from wind damage. The general planting of trees and shrubs, as field shelterbelts to aid in soil conservation and in crop protection, is not practical under all conditions of soil and climate; nevertheless, the establishment of field shelterbelts is practical and is strongly recommended for the specific soil conditions outlined in this portion of the report. (See also pages 48-49.)

The areas where field shelterbelts are needed and recommended in soil erosion control may be grouped under two headings, i.e.,

A. Areas where field shelterbelts are recommended as an aid in soil drifting control.

Areas in the prairie-aspen grove region where the soils have developed on lacustrine sediments, with smooth topography, and with either moist substrata or favorable soil-moisture climate. In such areas field shelterbelts can be used extensively and systematically as an aid in soil drifting control.

B. Contour planting of field shelterbelts and hedges.

Areas in the rolling or hilly portions of the wooded regions where field shelterbelts or hedges should be maintained on contour lines as an aid in the control of wind and water erosion.

A. Areas Where Field Shelterbelts are Recommended as an Aid in Soil Drifting Control:

The soils in the blackearth region that are developed on water sorted lacustrine sediments with smooth topography are particularly susceptible to soil drifting. However, it is important to note that the lacustrine sediments were deposited in basin areas. Hence (except where they have been channelled subsequently by streams), it is natural for ground water to accumulate in these basin-like positions, but especially so where the deposits are of light texture. The presence of ground water or a moist substrata below the light textured soils of the large lacustrine basins in the blackearth regions, favors the growth of a large number of trees and shrubs which can be planted and grown successfully on such sites.

The soils in the areas for which field shelterbelt projects are here recommended, as an aid in soil drifting control, may be placed in two groups according to the urgency of action required.

The first group includes the light textured soils developed on lacustrine and wind sorted deposits. On such soils, drifting is a common hazard and immediate adoption of soil drifting control measures is urgently needed. This group includes the arable soils of the Souris, Stockton and Almasippi soil associations, and the Altona light loams. These soils are designated on the sketch map (Fig. No. 4) as B_3. The Manitou clay loams should also be placed in this group because of the urgency of the soil drifting problem.

The second group includes the medium and medium heavy textured soils developed on lacustrine deposits. On such soils, drifting has not been so acute generally, but it is not of infrequent occurrence and soil drifting may develop as a serious source of injury unless preventive measures are taken. For such soils, field shelterbelts are here recommended as a long-time soil conservation program. This second group includes the arable soils of the Carroll, Glenboro, Holland, Wellwood, Portage, Altona, Emerson, Sperling and Beresford soils associations, etc. These soils are designated on the sketch map (Fig. No. 4) as B_4.

The primary purpose of establishing field shelterbelts is to secure a measure of soil and crop protection from winds, but it may be noted at this point that field shelterbelt trees can be used also for the production of fence posts, fuel and farm building or implement repairs, etc. Incidentally, the shelterbelts and hedges provide nesting places for birds and a haven for other forms of wild life. They also add an important scenic value to the countryside and when properly established, add values to the farms that cannot be appraised fully by monetary standards.

The value of field shelterbelts has been successfully demonstrated in Manitoba by a number of farmers acting on their own initiative. For example, a number of good field shelterbelts are to be seen in the Altona district. Some of these are willow hedges, which have not only demonstrated the usefulness of tree hedges for the protection of soil and crops from wind erosion, but have produced a crop of wood, harvested some years ago in such a manner that the subsequent coppice growth is now 25 feet high. Good, well-established field shelterbelts are to be seen also on individual farms in the Souris basin, where they are particularly effective on the light textured soils of that area. Field shelterbelts or hedges have played an essential part in the success achieved in the production of fruit and horticultural crops at the Morden Experimental Station and the Killarney Demonstration Farm.

When the Prairie Farm Rehabilitation Act was brought into being in 1935, provision was made to give assistance to associations of farmers in the planting of trees. Under this scheme only one field shelterbelt association was organized in Manitoba. This is located in the Lyleton district and is known as the Lyleton Project. The assistance granted consisted of (1) free planting material; (2) payment of $3.50 per thousand for planting; (3) payment of $20.00 per mile per year for cultivation and maintenance for a period of five years; and (4) the organization and supervision of the project by a tree planting supervisor. Further information on the Lyleton Project is given in Appendix 5.

A review of shelterbelt experience in other lands by Rudolh and Gervorkiantz* contains the following statement: "Probably the most obvious and certainly the most important effect of shelterbelts, especially on the wide, dry and dusty Russian Steppes, is their action in breaking the force of wind. Their other principal effects are directly or indirectly dependent on this." . . . "Height is generally agreed to be a dominant factor in the distance to which protection is extended by shelterbelts. Various investigations place the effective distance of a single shelterbelt as ranging from 10 to 30 times the height of the trees, and a figure of 20 times the height is commonly accepted. Measurements made at the Mariupol Station led to a more elaborate formula wherein the effective distance is placed at two and one-half times the square of the height of the belt when the meter is the unit of measurement."

Further evidence of the effectiveness of windbreaks is given by Bates for conditions in the plains region of United States.** "A windbreak of moderate effectiveness reduced the velocity of a 20-mile wind striking it squarely, for a distance equal to about 30 times the height of the trees. About one-fourth of the protected area is usually on the windward side and three-fourths on the leeward side. Thus, trees 65 feet high usually reduce the ground wind by 10 per cent. or more for a distance of 30 times 65 feet, or 1950 feet—over one-third of a mile." Bates also states: "A very dense tree belt allows only about 25 per cent. of open field velocity close in, and 80 per cent. at 20 heights with winds from 20 to 25 miles per hour. Such a belt reduced the wind at 30 heights to about 90 per cent. On the other hand, an open cottonwood belt . . . reduced the ground wind to lower than about 95 per cent. of the open field velocity near the trees, although further away it dropped to 80 per cent. before beginning to rise."

An observation in Western Canada of the protective influence of a shelterbelt on a crop of grain during a violent storm was made by Saunders*** at Indian Head. "The protective influence of the belt was very marked. The storm had been a very violent one . . . the trees were about 15 feet high and for 750 feet out the grain was green, well protected and in good condition, while beyond that it began to get thinner and thinner and for a few feet it was entirely obliterated. . . . We found that for each foot of growth, there was about 50 feet protection."

This observation is in line with a statement contained in Woodland Section Bull. No. 10, U.S. Soil Conservation Service,**** which records that "there is some protection 50 times the height and 25 per cent. protection at 20 times the height on the leeward side, and contrary to general belief, there is some slight protection to as much as 15 times the height on the windward side."

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*"Possibilities of Shelterbelt Planting in the Plains Region." Page 70, U.S. Forest Service, 1935.

**"The Windbreak as a Farm Asset," U.S.D.A. Farmers' Bull. 1405, Page 48 (1944).

***"Tree Planting on the Prairies," by Norman N. Ross, Dom. Dept. of Agric. Pub. 623, Page 3, 1939.

****"Recent Developments in the Study of the Influence of Windbreaks." Soil Conservation Service, U.S. Dept. of Agric., 1937.

More recently the Soil Research Laboratory* at Swift Current reports that: "A dense belt of trees 25 feet high will cause a reduction in wind velocity and evaporation to a distance of over 400 feet to leeward. The reduction will be greatest near the shelterbelt, with a velocity at 200 feet approximately 50 per cent. of that in the open."

There is sufficient evidence to show that, if maximum efficiency is to be obtained from the use of field shelterbelts, the plantations must be of sufficient height, and of the required shape and density. From the evidence, in respect to height and distance apart, it may be taken as a working rule that an appreciable reduction in wind velocity, due to field shelterbelts, may be expected on level topography for 20 times the height on the leeward side, and 10 times the height on the windward side.

The effectiveness of a field shelterbelt varies directly with its density. A field shelterbelt should have both crown cover and ground cover. In other words, where trees are planted to increase the height of the crown cover, it is also necessary to plant shrubs to provide ground cover, and thus to prevent air currents from penetrating through the shelterbelt between the ground and the tree canopy. The construction of a windbreak effects its efficiency. Field shelterbelts that are more open next to the ground will cause the winds to be deflected under as well as over the trees, so that the wind velocity on the leeward side directly adjacent to the open shelterbelt may be actually increased over that in the open. The tendency of wind to rush over, under, and around an obstruction makes a border planting of shrubs an essential part of a well constructed field shelterbelt. In addition to securing increased density by the use of shrubs on the outer rows in field shelterbelts, a further advantage of a sloping form of wind barrier is obtained. It has been estimated that the effectiveness of a windbreak is increased about 40 per cent. when a sloping barrier is added to a vertical windbreak.

It is obvious therefore that in the development of successful field shelterbelt projects, due consideration must be given to certain fundamental principles. It has been shown that the effectiveness of a field shelterbelt is determined by its height, by its density, and by its slope or form. These can be determined by the trees and shrubs selected, and by the planting arrangement.

In planning the layout of field shelterbelts, care should be taken to insure that the windbreaks and hedges conform to the local terrain. However, in the areas where field shelterbelts are generally recommended in Manitoba as an aid in soil drifting control, the topography is invariably smooth and level. On this type of terrain the topography does not present any serious problem to the laying out and planting of field shelterbelts; a grid system of planting can be followed and the rectangular form of fields retained. Many advocates of field shelterbelts recommend that the hedges be planted crosswise of the prevailing winds. This recommendation is not necessarily valid because it is not the prevailing winds only that are responsible for soil erosion. Wind velocity is more important than direction. Unprotected soil may drift with winds from any direction if the winds are of sufficient velocity and if unprotected soil is in condition to be moved by such winds. Consequently, in laying out a field shelterbelt, the object should be to provide the maximum possible protection, and to assume that injurious winds may blow from any direction.

In Figures Nos. 5 and 6 two alternative plans of field shelterbelts are given. These are presented as examples only of suitable layouts. Modifications can be made to suit individual or district requirements. In the examples given, the quarter sections are divided by primary shelterbelts and by main and secondary cross hedges.

The primary shelterbelts shown in Figures Nos. 5 and 6 consist of a minimum of three rows of trees and shrubs. (Five rows may be planted if a more dense windbreak is required.) The outer primary shelterbelts around each section should be placed about 180 feet inside the boundaries so that excessive accumulation of snow on the road allowances may be avoided. Primary windbreaks are also shown crossing the centre of each section from north to south and east to west. These may be either on the quarter-section line, or at such distance from it, that the strip of land between the shelterbelt and the quarter-section line, added to the strip between the road allowance and the outer primary shelterbelt, will constitute one-fourth or one-fifth of the area in the quarter-section, depending upon whether the quarter is divided into four or five equal sized areas. Because the primary shelterbelts are not sufficient to give complete protection, two, three, or more cross hedges are also required. Where only two cross hedges are planted between the primary shelterbelts on each quarter-section, they would be main cross hedges of tall growing species. Where three cross hedges are planted, the centre hedge should be a main cross hedge of tall species; the other two could be secondary cross hedges of shrubs or small trees. To avoid long open avenues along the roadways that would be exposed to north and south or east and west winds, buffers may be provided at intervals as shown in Figure No. 6.

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*"Soil Research Laboratory," Swift Current, Sask., Report of Investigations, Page 23, 1943.

In the planting of trees and shrubs for a field shelterbelt project it is important that the various species are selected and arranged so that the ultimate shelterbelts and hedges are of satisfactory height, density and form.

The various species of trees and shrubs suitable for field shelterbelts and hedges in Manitoba are included and described in Section VII of this report. However, the following examples are given of the essential and supplementary components suitable for (1) primary field shelterbelts and of the essential components of (2) the main cross hedges and of (3) the secondary cross hedges.

(1) PRIMARY FIELD SHELTERBELTS:

The primary shelterbelt should be of good height, of effective density, and of the desired form. It should consist of a centre row of trees, flanked by an inner row of bush-like trees or tall shrubs, and an outer row of shrubs or shrub-like trees. (Three rows may be considered to be the minimum, but five rows gives a somewhat better form and proportion.)

(a) Examples of essential components:

I. Species suitable for centre rows of primary field shelterbelts: elm; ash; cottonwood; Manitoba maple, etc.

II. Species suitable for inner rows of primary field shelterbelts: willows; Manchurian or dwarf Asiatic elm; lodgepole pine; Scots pine.

III. Species suitable for outside rows of primary field shelterbelts: caragana; shrub willows.

(b) Example of supplementary components:

Additional species should be introduced in odd corners, and at irregular intervals in the otherwise continuous inner and outer rows of primary field shelterbelts. These supplementary species may be introduced as spot or clump plantings to relieve the monotony, to give color, or to provide fruit and berries for home and wild life use.

Species in this category include: honeysuckle; lilacs; crabapple; saskatoon; highbush cranberry; choke cherry; pin cherry; wild plum; hawthorn; Rocky Mountain juniper.

(2) MAIN CROSS HEDGES:

The main cross hedges should be of good height and density. They may be single rows of medium-tall and bush-like trees and shrubs. However, three rows of trees and shrubs would be more effective.

Examples of suitable species:

Medium and large willows; Manitoba maple and caragana. If available, spruce could be used as an alternative.

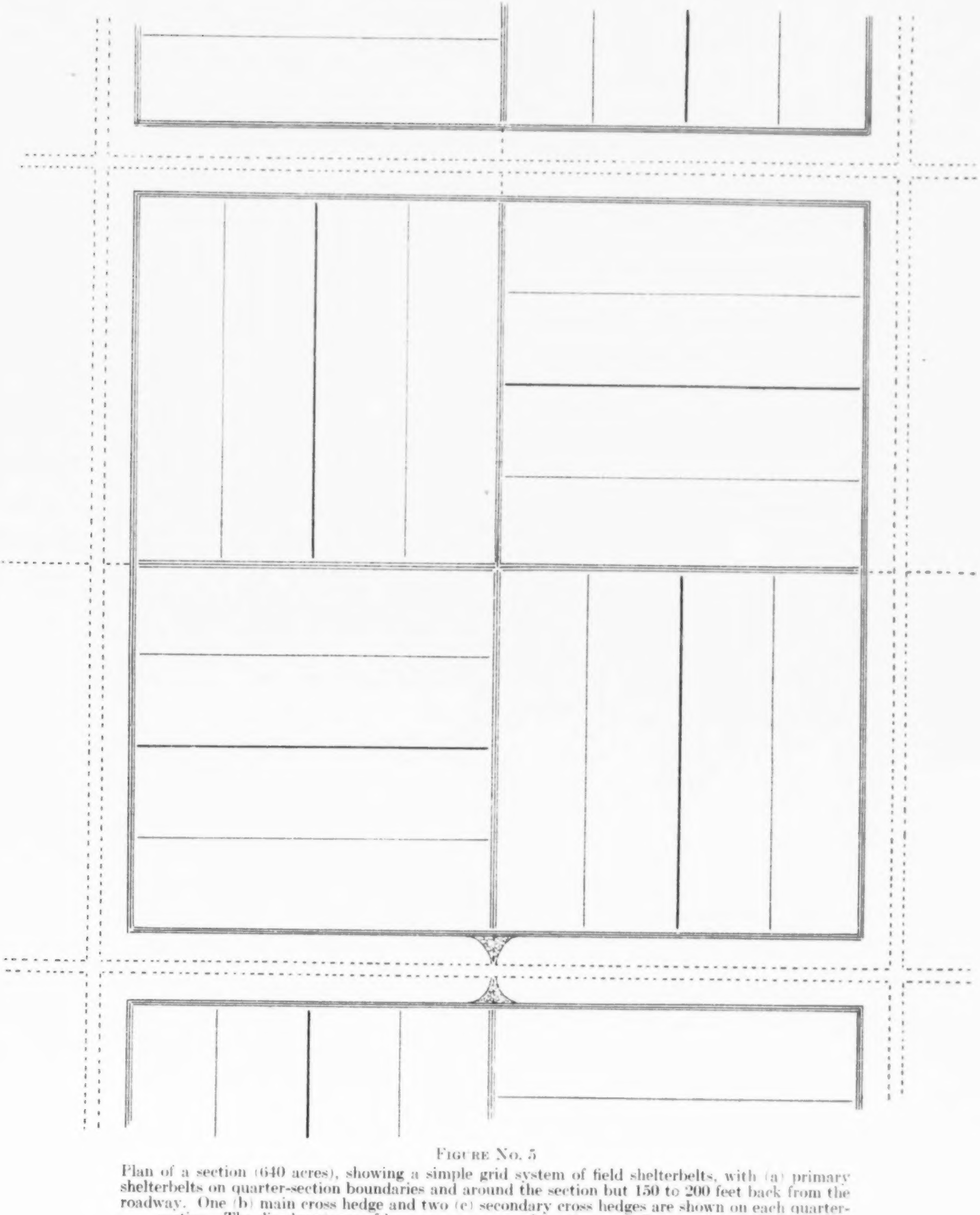

FIGURE No. 5

Plan of a section (640 acres), showing a simple grid system of field shelterbelts, with (a) primary shelterbelts on quarter-section boundaries and around the section but 150 to 200 feet back from the roadway. One (b) main cross hedge and two (c) secondary cross hedges are shown on each quarter-section. The disadvantages of long open avenues along the road allowances are apparent.

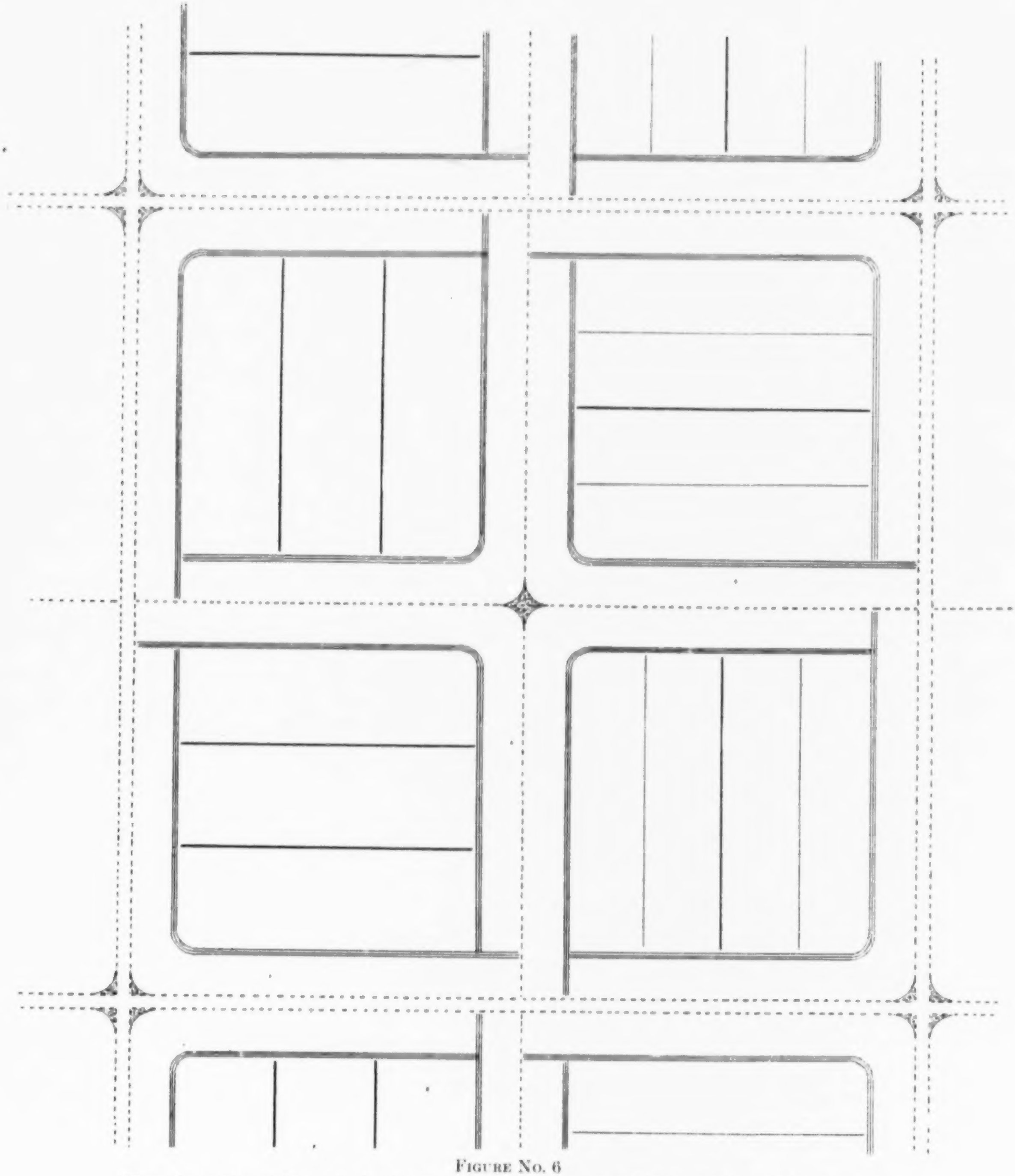

FIGURE No. 6

Plan of a section (640 acres), showing a more effective system of field shelterbelts designed to give better protection on sandy soils. Each quarter-section is divided by (a) primary belts and by (b) main and secondary cross hedges into four or five approximately equal sized fields. The alternate extension of the primary shelterbelts to the roadways forms baffles to break the open avenue effect along the road allowances, and rounded corners facilitate the working of the long outer fields. Clump plantings can be installed at crossroads, and as filling in the otherwise square hedge corners, for scenic effect, for fruit, and for wild life use.

(3) SECONDARY CROSS HEDGES:

The secondary cross hedges should be of moderate height and of good density. They are supplementary to the main cross hedges and primary shelterbelts. Fairly dense shrubs are required, which may be planted in single or double rows.

Examples of suitable species:

Caragana and bushy willows. An occasional tree could be planted in the hedgerows.

B. Contour Planting of Field Shelterbelts and Hedges:

Where the topography is more or less level and smooth, and where field shelterbelts and hedges are to be established, the plantings would be arranged invariably and logically in a grid or rectangular system as shown in Figures Nos. 5 and 6. However, where the topography is strongly undulating, rolling or hilly, a uniform grid system of field shelterbelts is not suitable.

If it is necessary to plant field shelterbelts and hedges under such conditions, the tree and shrub plantings should be made on suitable contours. Where the crests of hills and sharp knolls are subject to severe wind erosion, and where the removal of soil from the crests cannot be controlled by other means, it would be sound practice to seed such sites down to grass-legume mixtures, or to convert them into woodlots.

In addition to the use of field shelterbelts and hedges as an aid in soil drifting control, field shelterbelts may be utilized on the contour of hilly and sloping lands as an aid in the control of water erosion. This practice is more applicable to the hilly and sloping lands of the Manitoba escarpment, and on the Turtle and Riding Mountains. On such sites the native vegetation is forest or woodland invasion of prairie.

Where clearing and new breaking are undertaken on such lands, the clearing should be done around the slopes, so that strips of native trees and shrubs are left on contour lines. These strips of native woods can then serve as field shelterbelts, that not only will produce wood products, but will also act as natural buffers and thus would retard or slow down run-off, and aid both in soil and in water conservation. These wooded contour strips could be improved and supplemented by the introduction of utility trees and shrubs if such action were necessary to make them more effective and permanent. Where excessive clearing has taken place, and where soil and water erosion is in progress or is threatened due to excessive run-off, field shelterbelts should be established on contour lines.

Suggested lines of action:

The various extensive field shelterbelt projects outlined above involve certain definite lines of action.

I. An administrative policy would have to be formulated, and machinery set up to facilitate co-operative action between Provincial and Municipal Governments, farmer organizations, and individual farmers.

II. A staff of technical workers and advisors with both agricultural and farm forestry training, would be required. These technical workers would be needed to initiate educational campaigns; to establish and control demonstrational areas; to organize district field shelterbelt projects;* to direct, assist, and advise in the establishment, layout, and planting of the projects; and to assist and advise in respect to the subsequent management and maintenance of the various field shelterbelt projects.

III. Adequate nursery facilities would have to be provided to insure the production of the large amount of planting stock necessary. However, as nursery facilities also would be needed for the farm woodlot projects outlined in Section VIII, action in respect to the nursery woodlot and shelterbelt projects no doubt could be co-ordinated and unified.

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*Tractor-drawn tree planting machines have been designed and are being used by the U.S. Soil Conservation Service to plant field shelterbelts rapidly. Similar tree planting units could be used to speed up the planting of field shelterbelt areas in Manitoba.

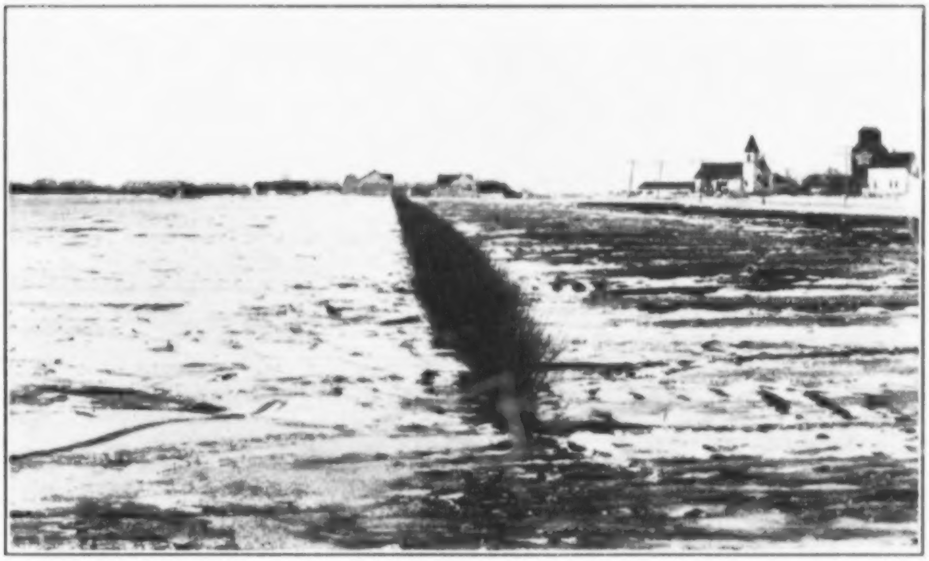

ILLUSTRATION No. 54

Young caragana hedge planted to trap snow and protect the highway. Effective but rigid and monotonous. Spot and clump planting of trees and of flowering and fruiting shrubs at intervals in the hedge and as clump plantings to fill in the square corners, that are difficult to work at the end of the fields, would break the rigidity, relieve the monotony, add color and attractiveness and provide better shelter and food for wild life. (Photo by courtesy Provincial Highways Branch.)

Illustration No. 55

Contrast of growth between caragana and willow in hedge planted by Highways Branch, Public Works Department. Caragana is here planted in the normal position and willow planted in the lower position. (No. 1 Highway, west of Brandon.) (Photo by courtesy Provincial Highways Branch.)

Illustration No. 56

Willow hedge planted by Highways Branch (No. 1 Highway, west of Brandon). Compare this with a caragana hedge shown as Illustration No. 55. (Photo by courtesy Provincial Highways Branch.)

X. OTHER TREE CULTURE PROJECTS

The systematic development of farm woodlots as a land use program, and the extensive development of field shelterbelts for soil conservation purposes, as recommended earlier in this report, may be considered as more or less of an innovation insofar as this province is concerned. Consequently, special provision (or some new form of organization) would have to be inaugurated if such projects are to be put into effect on the scale of action outlined. The other tree culture projects that have been set forth in summary Table No. 4, pages 40-45, may be considered as an enlargement of programs already inaugurated by different agencies. For example, certain departments of Provincial Government, and in some cases municipal councils, have already undertaken various forms of tree culture in connection with (1) highway planting; and (2) recreational areas. There is the further challenge of tree planting for (3) drainage ditch protection. Many town or municipal councils, and numerous residents of urban centres, have undertaken the task of (4) town and village plantings; and on the farms in the prairie-aspen grove region there has been varied interest and activity in establishing (5) farmstead shelterbelts, but much less interest and activity in (6) tree planting around farm dugouts.

(1) HIGHWAY PLANTING:

(a) *Main highways:*

Considerable pioneer work has been done by the Provincial Highways Branch in the planting of hedges (chiefly caragana) for highway protection against drifting snow. These hedges were planted primarily for utility, and the officials concerned are to be highly commended for initiating and carrying on this very desirable project. It is strongly recommended that the officials and departments concerned be given further and continued support and that this program be considerably enlarged. In addition to utility planting of highway hedges for the purpose of preventing the accumulation of snow drifts on the highways, landscape planting should be undertaken for scenic effect. A uniform hedge of caragana or willow, planted 120 to 200 feet back from the edge of the right-of-way, may be completely satisfactory from the utilitarian aspect of protecting the roads against winter snow drifts; but to the tourist, driving along such a highway in summer, the uniform hedges may present a monotonous aspect. A more natural and pleasing effect could be obtained by the introduction of supplementary species of trees and shrubs at irregular intervals in the otherwise continuous hedge rows, and by the planting of naturalistic clumps in the square corners of the rectangular strips that lie between the hedge rows and the highways. Trees and shrubs that could be used to good effect to supplement the caragana and willow, which have been more extensively used for highway hedges in the past, include: elm; green ash; white and Colorado blue spruce; lodgepole and Scots pine; dwarf Asiatic elm; Britzensis willow; crabapple; honeysuckle; wild plum; Rocky Mountain juniper; buffalo berry; Russian olive; highbush cranberry; lilac; dogwood; and cotoneaster, etc. The introduction of such supplementary plantings of trees and shrubs and their addition to the essential components of highway hedges would make them more attractive by the addition of color; would relieve the monotony by presenting a more natural form; and would provide food and a more varied haven for birds and wild life.

(b) *Scenic highways:*

Another aspect of tree culture is the conservation and improvement of the naturally wooded areas where scenic highways could be developed. For example, the Pembina Valley from the International Boundary to Swan Lake has a wild and rugged appearance. "The rugged wooded slopes and the rough splendor of the valley through which the Pembina River at times runs in a torrent, but at other times flows as a murmuring stream, is in marked contrast to the quiet beauty of the lake adorned central section" (that is between Swan Lake and Bone Lake). "The whole valley, however, is remarkable for its beauty and its contrasts. A highway built within and along its course would provide a scenic drive second to none in the prairie region."*

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*Soils Report No. 4, Manitoba Soil Survey, P. 26.

With this section of the Pembina Valley as a starting point a continuous scenic highway connecting natural beauty spots could be constructed from the International Boundary to northern Manitoba. A route could be followed along the Pembina channel to Swan Lake, then northward through the Tiger Hills moraine to No. 2 highway, thence northward to cross the wide terraced valley of the Assiniboine and through the sand hills of the Spruce Woods Forest Reserve to link up with No. 1 and No. 10 highways and so on to Clear Lake and Riding Mountain National Park.

In addition to the example given, there are a number of deep wooded ravines and wide river valleys in the prairie-aspen grove region which are natural beauty spots. In future highway development for tourist use, full benefit wherever possible should be taken of these natural wooded areas by connecting such sites to the general highway system. If this is done the scenic possibilities of silvicultural work along the highways would open up a further important aspect of highway planting.

(2) RECREATIONAL AREAS:

Another type of project that is related to highway development and tourist traffic is the development and maintenance of various types of recreational areas. Where the naturally wooded stream valleys are within close proximity to the main highways, they provide excellent sites for picnic grounds, tourist parks, and local recreational centres, etc.

(*a*) *Picnic grounds:*

In normal times the highways close to urban centres are crowded with cars during weekends and holidays, filled with people looking for suitable places where they can "hold a picnic." It is suggested that a large number of small picnic grounds, located at suitable points along the naturally wooded valleys of the Red and Assiniboine Rivers, etc., and close to the main highways, would fill a long felt public need. Such a project need not entail a large amount of cost or labor. The main work involved would be (1) the clearing of underbrush, (2) the cutting and removal of undesirable or dead trees, and (3) the maintenance and protection of the native shade trees. A further improvement, however, would be effected by connecting such sites to the main highways by passable roads.

(*b*) *Tourist parks:*

The development of tourist parks in the naturally wooded beauty spots is a somewhat similar project. However, while some of these have been (and in many cases continue to be) carried on by private enterprise, others are located on recreational grounds or parks under municipal administration.

(*c*) *Recreational centres:*

There is another form of recreational use that is being made of hilly areas with some natural tree cover, namely ski-slides and winter sport grounds. Certain places on the steep ravines and slopes of the Manitoba escarpment could be developed not only as sites for ski-slides and winter sport grounds, but also as summer camping grounds and local recreational centres. The protection and maintenance of the native woods on the lands which flank the ski-slides, and the improved beautification of the woods by the introduction of conifers, etc., would be a worthwhile project which would add greatly to the recreational value of such centres. To make a success of this project the active support of interested parties would be essential. Tourist bureaus, ski clubs, snowshoe and toboggan clubs and the local municipalities concerned could no doubt be induced to co-operate and assist in such a scheme.

(3) DRAINAGE DITCH PROTECTION:

In the Red River plain, the protection of the extensive system of open drainage channels has become a serious problem. The flat topography of this imperfectly drained region and the general absence of trees or other natural barriers to the unhampered movement of winds over the surface predisposes to the movement of soil material, especially when land is fallowed and when the soil is pulverized by alternate freezing and thawing in the absence of snow cover. Under these conditions, soil from fallow fields is carried or rolled into the adjacent ditches. In some cases fairly large ditches have been more or less completely filled with "soil drift." The periodic cleaning out of the drifted soil material, and maintaining the efficiency of the drainage ditches necessitates recurrent heavy expenditures.

To aid in the protection of open ditches from drifting soil and to reduce the cost of maintenance, it is recommended that hedges be planted parallel to the ditches. These hedges would have to be planted on that side of the drains opposite to the spoil bank and at a sufficient distance back so that snow drifts would not accumulate over the ditches unduly. The Drainage Act requires that on this side of the ditch a strip of land 75 feet wide be seeded down to grass; however, in practice, fields are often cultivated right up to the ditch. The establishing of hedges and the seeding down of the strip between the hedges and the ditch would be a real safeguard. In selecting hedge material for planting alongside drainage ditches the limitations of trees and shrubs that propagate readily from seed should be recognized. Such species should be avoided. The moist soil in the ditches and ditch banks favors the germination and growth of the seeds of cottonwood, Manitoba maple, green ash and elm, etc. Hence, trees of such type would tend to spread and form a ribbon of forest growth within the ditches and thus incapacitate the drains. Moreover, as the drains invariably traverse the imperfectly drained portions of the terrain, shrubs (and trees) that require well-drained sites are also unsuitable. The cultivated willows would appear to be the most promising plants for ditch hedgerows. They are not only fairly tolerant of periodically moist conditions, but they are reproduced or propagated by cuttings. Their economic value as fence posts and fuel in an area where these commodities are absent, together with their serviceability as hedgerow plants, makes them particularly suitable for this project. A beginning should be made to demonstrate their usefulness and serviceability.

(4) TOWN AND VILLAGE PLANTINGS:

The tree culture project, to which attention is here drawn, is the renovation of the apparently neglected over-age and dying trees frequently found in the streets of many of the smaller rural towns and villages. No criticism is implied and no reference, except commendation for the work accomplished, would be justified in respect to the excellent civic tree culture projects of the cities and larger towns. The same is true of the well-cared for plantings such as are found in many rural cemeteries, memorial grounds and small parks sponsored at various points in the province by local councils, veterans' organizations, service clubs and others. Nevertheless, these good examples do not alter the fact that the renovation, replacement, and improvement of the trees planted in many prairie towns and villages are urgently needed and long overdue.

In most of the rural towns and villages in the prairie-aspen grove region of Manitoba, trees have been planted on the streets as a community project, and on residential lots by individuals as a private enterprise. In a number of the villages in the southern portion of the Red River Valley, and within easy access of the Pembina River, native cottonwood was freely used. These local cottonwood plantings (supplemented in some cases with Manitoba maple) were a pioneer enterprise undertaken in 1876 and in subsequent years. (See Appendix 2, p. 110.) However, in the remainder of the province general activity in town and village planting appears to have been initiated later or about 40 or 50 years ago, because many of the trees now range from 40 to 55 years of age. The plantings made during this period in the prairie towns and villages were largely of Manitoba maple or boxelder. The wide use of this indigenous species was doubtless due to the ease of obtaining seed and planting stock and to the fact that the superior values of elm and ash for town plantings had not yet been demonstrated in this province. At the present time, as tourists drive through rural towns and villages, they cannot fail to be impressed by the large number of over-aged, dying and dead maple trees that fringe so many of the streets and lots. It is imperative, therefore, that the replacement and renovation of the older town and village plantings must be undertaken if they are to be made attractive and maintained as community assets. In younger plantings, where Manitoba maple has been extensively or exclusively used, a partial replaçement by more desirable and longer lived species should be undertaken as an improvement program. The superiority of elm and ash over Manitoba maple for street planting has been convincingly demonstrated by some of the cities and larger towns, and this practice of introducing more desirable species of trees should be extended likewise to the smaller towns and villages. Civic or community responsibility does not end with an Arbor Day that is past, or with a transitory or periodic show of activity in tree planting on an Arbor Day that is to come. Provision should be made for systematic development, for maintenance and for continuity of interest. In the future, the street planting activities in towns and villages might well be extended to include the establishment and maintenance of civic centres and village playgrounds. There is also need for improved designs in the layout and planting of trees and shrubs in prairie towns and villages. The planting designs should be improved not only from the standpoint of making them more attractive, but also from the standpoint of meeting more effectively the local problems of soil and climate. For example, in the drier parts of the prairie region, the soil reaction, the periodic dry conditions, and the limited water supply affect not only the choice of tree and shrub species, but they also give rise to layout and planting problems. Layout and plantings should be planned to make best use of the available water to grow trees that will shade the streets and protect the buildings, but that at the same time will not compete unduly with the production of lawns and gardens on the residential lots. It is recognized that town and village plantings are a local responsibility and are under the jurisdiction of the local town or municipal councils. Nevertheless, where no parks board is maintained, there would appear to be a need for a regional technical advisory service to aid the local authorities in educational campaigns, and to give advice and leadership in planning and maintaining better town and village plantings.

(5) **FARMSTEAD SHELTERBELTS:**

The establishment of farmstead shelterbelts to act as windbreaks for farm home and building sites has been the major tree culture activity carried on in the prairie and aspen grove regions of Manitoba. Records show that as early as 1876 and 1877 the pioneer settlers obtained native seedlings and tree seeds from the wooded fringes of the streams and the wooded hills of the escarpment and with these they initiated the farmstead shelterbelt program. The trees thus obtained were broad leaved species. Later, however, settlers in the upper Assiniboine delta obtained native white spruce from the sand dune area and used these conifers in conjunction with the Manitoba maple chiefly used in the early days in that portion of the province. This private enterprise later received governmental encouragement that was expressed by the production of tree seedlings on government farms and by the distribution of these seedlings to farmers (either free or for a nominal sum). From 1889 to 1904 the Brandon Experimental Farm collected and imported tree seeds, produced both native and introduced seedlings, and these seedlings were distributed to farmers for shelterbelt purposes. In 1903 the Dominion Forest Nursery Station was established at Indian Head, Saskatchewan, and the work of producing trees for prairie farmstead shelterbelts was transferred from the Brandon Experimental Farm to the Indian Head Forest Nursery. (See Appendix 4.) Later (in 1914) another Dominion Nursery Station was established at Sutherland, Saskatchewan. Undoubtedly, the stock from the Brandon Experimental Farm and the Dominion Forest Nursery has been the greatest source of planting material used in the farmstead shelterbelts on Manitoba prairies, but it has been supplemented by ornamental and utility planting stock purchased by the farmers directly from commercial nurseries. The number and species of trees distributed under the Dominion Government tree planting policy, and used from time to time in farmstead shelterbelts in Manitoba, have been made available through the courtesy of Walker and Edwards.* This information thus obtained, is here presented in a reconstructed form to give an authentic picture of the overall species composition of the farmstead shelterbelts developed from that source in Manitoba.

The number of trees distributed by five-year periods from 1901 to 1944; the total number and percentage of each tree species distributed during this 44-year period, and the fluctuation in species distribution indicated by the relative percentage of the different species in each of the five-year periods are shown in Table No. 6.

The figures in Table No. 6 show that of the 28 million seedlings distributed in Manitoba 8.9 million were caragana and 19.1 million were trees. Of the 19.1 million tree seedlings 96.5 per cent. were broad leaved tree species and only 3.5 per cent. were conifers. The summary totals show that the broad leaved species were made up of Manitoba maple, 40.5 per cent.; green ash, 23 per cent.; willows, 17.05 per cent.; poplars, 13.14 per cent.; elm, 6.29 per cent., and birch, 0.01 per cent.

The coniferous species were made up of spruces, 62.57 per cent.; pines, 34.92 per cent.; and larch or tamarack, 2.51 per cent.

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*Private Communication, J. Walker, Superintendent, C. A. Edwards, Assistant Superintendent, Dominion Forest Nursery Station, Indian Head, Sask.

Table No. 6—The Number and Per Cent. of Tree Species Distributed in Manitoba for Farmstead Shelterbelts under the Dominion Tree Distribution Policy (1901-1944)

	1901–1905	1906–1910	1911–1915	1916–1920	1921–1925	1926–1930	1931–1935	1936–1940	1941–1944	Total Number	Total in Per Cent.
BROAD LEAVED TREES:	%	%	%	%	%	%	%	%	%		
Manitoba Maple	47.15	48.40	41.05	37.40	31.00	40.60	38.93	36.33	38.40	7,473,995	40.51
Green Ash	24.77	21.64	24.49	23.80	15.30	18.31	28.84	30.18	24.86	4,242,705	23.00
White Elm	13.43	6.15	1.20	....	....	0.21	5.60	15.77	16.01	1,161,175	6.29
Russian Poplar	2.68	5.89	3.94	16.50	24.88	15.29	9.44	0.69	0.30	1,714,050	9.29
Poplar Hybrids	....	....	....	....	....	2.64	2.63	5.36	4.89	283,700	1.54
Cottonwood	8.72	4.80	3.76	....	0.05	0.006	0.08	0.04	0.65	426,595	2.31
Birch	....	0.03	....	....	....	0.06	....	....	....	2,650	0.01
Laurel Willow	....	....	....	0.18	12.50	10.80	2.93	2.84	1.59	696,675	3.79
Acute Willow	3.25	13.09	25.56	15.69	9.15	11.86	11.50	8.80	13.29	2,167,425	11.75
Red Willow	....	....	....	6.43	7.12	0.22	....	....	....	278,750	1.51
Total	100 = 2,462,475	100 = 3,000,470	100 = 1,476,150	100 = 1,678,025	100 = 2,320,880	100 = 2,585,775	100 = 1,543,910	100 = 2,037,760	100 = 1,342,275	18,447,720 = 100.00 *Broadleaf Trees =96.5%*	
HEDGE SHRUBS (CARAGANA)	....	3,225	35,625	245,550	713,275	1,320,170	1,266,200	3,426,225	1,971,810	8,982,080	....
CONIFEROUS TREES:											
Siberian Larch	....	....	1.54	....	....	....	0.78	....	....	1,860	0.28
Tamarack	....	60.52	8.81	....	....	....	....	....	....	14,950	2.23
Scots Pine	....	30.60	12.18	15.79	41.52	52.68	28.79	22.09	15.47	159,724	23.87
Jack Pine	....	2.37	12.77	22.12	23.76	11.18	....	....	....	50,100	7.49
Lodgepole Pine	....	....	17.84	9.94	0.19	2.56	....	....	....	23,850	3.56
White Spruce	....	1.52	33.91	52.14	34.53	33.58	70.43	63.21	48.41	337,195	50.39
Colorado Spruce	....	0.26	1.65	....	....	....	....	14.70	36.12	73,136	10.93
Norway Spruce	....	4.73	11.30	....	....	....	....	....	....	8,400	1.25
Total	....	100 = 14,788	100 = 68,125	100 = 102,600	100 = 51,550	100 = 54,575	100 = 103,640	100 = 125,930	100 = 148,007	669,215 = 100.00 *Conifers = 3.5%*	

In the early stages of the tree planting program in the prairie region where trees are being planted on different growth sites in an area as extensive and varied as the grassland and aspen grove regions, it is natural to expect that there would be a wide fluctuation in the tree varieties and species distributed from time to time. In cases where an attempt is being made to ascertain the suitability of a species for a given area by the trial and error method, a number of years must elapse between the time of planting and the time when the suitability or otherwise of a given species is demonstrated. Consequently, the species of seedlings produced in the distributing nurseries would have to be modified from time to time in the light of their performance in the shelterbelts, and in response to the requests and desires of the recipients of the nursery seedlings.

During the period from 1876 to the present time, the farmstead shelterbelts that have been planted from native and introduced tree species are so numerous that they provide a good coverage of various sites in the grassland and aspen grove regions. It is opportune, therefore, that a detailed study should be made of the farmstead shelterbelts and of the condition of the component tree species. The objective of such a survey would be to group the growth sites, and from a tree culture standpoint, to determine the species of trees that should be recommended as suitable and satisfactory for each of the varied conditions and to formulate a sound long-term policy in respect to farmstead shelterbelts.

A general inspection of the existing farmstead shelterbelts confirms the impression suggested by a study of the information given in Table No. 6, namely, that from a maintenance standpoint, the component farmstead shelterbelt trees may be divided into three groups.

First, there are those trees that, under prairie conditions, become decadent before reaching full or normal maturity and require replacing with improved species.

Second, there are those trees that can be retained as suitable shelterbelt trees for many years, but which have a utility value as a *crop* before they are fully mature, and which can be renovated by the simple process of cutting and coppice.

Third, there are those trees that are long lived and require many years to reach maturity and that may be expected to be serviceable windbreak trees for many years.

Therefore, even though there are a large number of farmstead shelterbelts which have been established, a program of replacement, renovation, and maintenance will have to be undertaken if they are to be preserved. In the older farmstead shelterbelts, especially where Manitoba maple was largely used, prematurely old, dying and dead trees are becoming common. Provision should be made for their replacement. Replacement of unsuitable and diseased trees (e.g., cankered Russian poplar) should be made with species that are more desirable, longer lived, and better suited to the growth site.

Many of the willows and cottonwoods are at the stage where they should be renovated by the coppice system. This consists of cutting the trunk close to the ground, which induces regeneration by rapidly growing shoots. The maintenance of existing plantations, as well as the establishment of new shelterbelts, must be considered as an essential part of the future tree culture program.

In connection with a future farm shelterbelt program, consideration should be given to a co-ordination of the educational agencies that are attempting to give leadership in the layout, the planting and the management of windbreaks. The farmstead shelterbelt program in Manitoba was originally initiated and carried out by private enterprise. The success of these initial plantings was due largely no doubt to the knowledge, the ability, and the good husbandry of the settlers as well as the fact that native stock obtained locally was used. Later, although the planting and growing of shelterbelts remained an individual farm enterprise, the Dominion Government policy of producing and distributing tree seedlings was a prime factor in encouraging and stimulating this project.

In addition, through the years, various agencies have undertaken to give leadership and instruction in respect to the suitability of varieties and in respect to the layout, planting and management of trees on the prairies. These agencies include Dominion and Provincial Government Departments, educational institutions and extension services, and various private and public supported associations and commercial organizations. Credit must be given for the good intentions that have motivated these agencies, but it also must be recognized that there is liable to be confusion or difference of opinion unless the various educational and administrative agencies are brought together so that their fundamental objectives may be defined, and their policy formulated, in the light of the conditions and local requirements, and of their suitability to soil and site. Characteristics of the growth sites that are met with must be recognized. These are so varied that a stereotyped planting list and a rigid planting layout for farmstead shelterbelts must be avoided. It is recognized that there are certain fundamental principles that should be understood and incorporated in each layout; at the same time the layout should satisfy the specific need of each farmstead; it should fit the landscapes or local site conditions; and it should express the individuality of the owner.

In the future, it is highly desirable that the educational program of the various inspirational agencies should be in the nature of a unified approach along co-operative lines.

(6) DUGOUTS:

In areas where satisfactory supplies of well water cannot be obtained, the installation of dugouts for water storage has been extensively followed in the province and will no doubt be further developed in the future. The necessity for the improvement of dugouts is pointed out in "Soils Report No. 3."* "The water development policy followed in the past should be supplemented and extended through the initiative of both individuals and committees. Not only should the dugouts on individual holdings be of sufficient size to satisfy the annual water requirements of the respective farms, but in addition, amply constructed reserve dugouts should be provided to insure adequate supplies of water in exceptionally dry periods, and to provide irrigation water for farm gardens in emergencies.

"The construction of dugouts should be given more careful consideration and attention by farm operators. Where dugouts have been excavated in the past, the practice has been to dump the excavated soil as spoil banks along the edge of the excavations. It is suggested that as a general practice the spoil bank should be removed from the edge of the excavations, and used for the construction of low dykes around or immediately adjacent to the respective dugouts. These dykes could be used either to increase the storage capacity or in some cases they could be placed so that the land between the dugouts and the raised dykes may be used for garden sites. Box checks and water gates would have to be constructed in such dykes so that the surplus water could be controlled and injury to the dykes prevented. The unsightly spoil banks would thus be eliminated and made to serve a useful purpose. The low dykes should be seeded down to grass, and windbreaks could be planted to provide snow traps."

The judicious planting of trees and shrubs should be at a suitable distance from the dugouts to collect the snow. Whether the area between the dugouts and the protective tree and shrub plantings is intended for garden use or not, the plantings in any case should be far enough back to allow plenty of room for clean-out operations in case some silting up of the dugouts occurs. Moreover, the larger the area enclosed by the plantings, the greater will be the amount of snow that can be entrapped.

Continuous hedges are not so suitable for planting around dugouts as suitably arranged clumps. Breaks between the clumps permit some movement of air through the enclosed area. In planting around dugouts, it is recommended that the conifers be used due to the fact that the broad leaved trees shed their leaves, and the fallen leaves tend to be carried by wind and water into the dugouts. Hence, they are not as suitable as the evergreen trees and shrubs. Suitable grouping of blue and white spruce; Scots, lodgepole and jack pine; and of Rocky Mountain juniper could be used in any manner that is suitable to the local site for the purpose of obtaining maximum dugout efficiency. The trapping of snow will be more effective if the clumps are not too dense.

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*Soils Report No. 3. Manitoba Soil Survey. P. 92.

ILLUSTRATION NO. 57

Elm, Manitoba maple, etc., growing in a drainage channel north of Sperling. Tree seeds that are carried by wind and water germinate readily in the moist soil of the ditches. Subsequently they make rapid growth and incapacitate the drains. To protect ditches from soil drift, hedges should be used that do not produce seed, but which are propagated vegetatively (i.e., introduced willows).

ILLUSTRATION NO. 58

Cottonwood seedlings growing naturally in a blowout south of Elva. Seed was blown from an adjacent farmstead windbreak and germinated readily in the moist soil surrounding the flooded depressions, banked around by soil drift. (Started 1933-35—Photo taken 1939.)

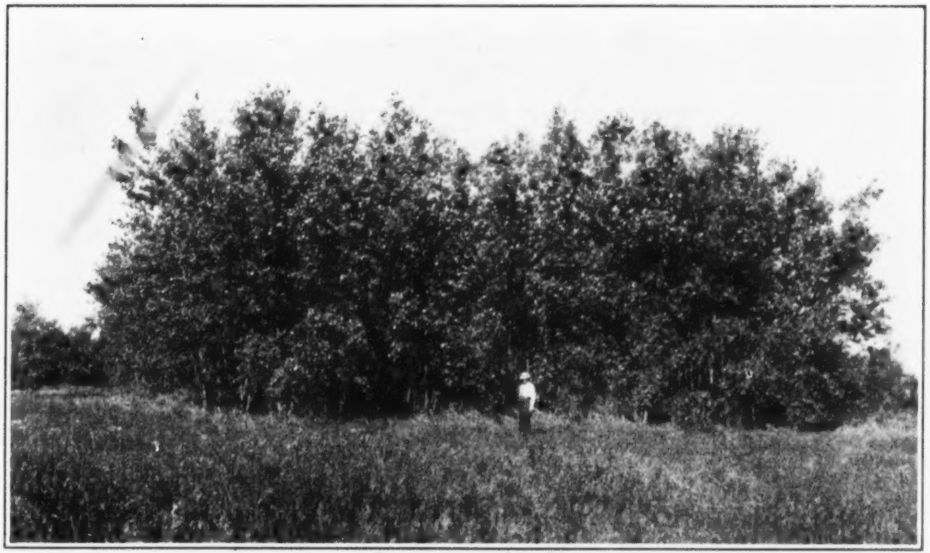

Illustration No. 59

Volunteer cottonwood, approximately ten years old, in a moist sandy blowout south of Elva. Photo taken 1944. (See Illustration No. 58.)

Illustration No. 60

Close up of volunteer cottonwood shown in Illustration No. 59. Photo taken 1944.

Illustration No. 61

Illustration No. 62

Many farmstead plantings require renovation. The stag-horn effect of over-age Manitoba maple is all too common. In Manitoba farmstead plantings this pioneer tree should be replaced by elm, ash and conifers.

* * *

Manitoba maples in a farmstead shelterbelt that have outlived their usefulness. These trees should be harvested when mature and before they have reached this decrepit stage.

Illustration No. 63

Highway through a Mennonite village fringed with cottonwoods planted by the early settlers, on Altona soil association. Some of the cottonwoods in the background are approximately 65 years old and around 85 to 90 feet high.

Illustration No. 64

Attractive farmstead in Mennonite village, showing the excellent development of trees (chiefly native cottonwood), planted on what was originally open prairie in the southern portion of the Red River plain. (See Appendix 2.)

XI. ADMINISTRATIVE ACTION INVOLVED IN THE IMPLEMENTATION OF A PROVINCIAL FARM FORESTRY AND TREE CULTURE PROGRAM

The implemention of the enlarged tree culture program outlined in this report involves the following:

(1) The appointment and adequate support of a provincial farm forestry and tree culture unit or branch;

(2) The establishment of farm forest nurseries to insure an adequate supply of seedlings or planting stock for provincially sponsored projects;

(3) The various aspects of labor, supervision and administration that must be variously provided, depending on the public or private nature of the respective projects.

(1) THE APPOINTMENT OF A PROVINCIAL FARM FORESTRY AND TREE CULTURE UNIT OR BRANCH:

The appointment of a provincial farm forestry unit or branch is highly desirable. Such a unit or branch would be the logical medium through which a provincial farm forestry and tree culture program could be conducted so that continuity and co-ordination of action may be assured. This unit should be composed of full-time technical workers trained in farm forestry and agriculture, attached to an appropriate department of government or to the university. (Logically, it would become an essential unit of a conservation service if such were created.)

This branch could be assigned the following duties:

(a) To plan and put into operation the woodlot and field shelterbelt projects required;

(b) To demonstrate in a practical way the most suitable and profitable silvicultural practices on demonstration areas of typical natural woodlots;

(c) To establish demonstrational woodlots on individual farms;

(d) To act as advisors in woodlot management to farmers, municipal officials, and others;

(e) To organize field shelterbelt projects and assist in the establishment, layout, planting, and subsequent management of such projects;

(f) To initiate and develop such new tree culture projects as may be required;

(g) To conduct investigational and educational campaigns;

(h) To give leadership, to extend co-operation, and to supply technical supervision and advice in the enlargement of other tree culture projects already under way, etc.

The appointment and active support of a provincial technical farm forestry unit if adequately staffed and financed, and detailed to give full time to this work, would permit a scientific approach, a co-ordination of activities, and a continuity of action.

(2) THE ESTABLISHMENT OF FARM FORESTRY NURSERIES:

It has been shown earlier in this report that although some of the original tree plantings were established by the use of "wildlings" obtained locally, the chief source of windbreak and utility tree planting material has been the Dominion Forest Nurseries with additional materials and ornamental stock supplied by commercial and private nurseries. Up to the present, the Provincial Nurseries on the forest reserves have not been used as a source of planting material for prairie farms. These nurseries have been maintained exclusively for the production of stock for afforestation on Crown lands.

It is obvious that the large amount of planting material required in the major projects of farm forestry and field shelterbelts outlined in this report cannot be supplied adequately from the existing sources of supply. New and well equipped forest nurseries are needed to produce the utility stock for these two projects, and for the enlargement of the projects that are now being developed by certain provincial departments. Strategically located farm forest nurseries should be established under the control and direction of the provincial farm forestry and tree culture unit already mentioned.

This production of utility stock for the provincially sponsored projects would not take the place of planting stock now being supplied for existing projects by Federal and private enterprise. The latter agencies logically could be expected to fulfill the same functions and supply the same needs in the future as they have done in the past.

(3) VARIOUS ASPECTS OF LABOR, SUPERVISION, AND ADMINISTRATION:

The task of planting and the subsequent care and management of the respective tree culture projects, involves labor, supervision and management that will be variously provided, depending on the private or public nature and magnitude of the different projects. Some of the projects are essentially private enterprises; some will be carried on by municipal or town councils and local boards; and others would need to be government supported if they are to be successfully carried out.

Thus in practice, farmstead shelterbelts, farm woodlots, and plantings around dugouts may be classed as private projects on individual farms, but the establishment of municipal woodlots, and the improvement, maintenance, and extension of town, village and school plantings, are local public activities under the jurisdiction of town and municipal councils or local boards. The other projects discussed in this report may be classed as general public projects that will have to be sponsored either as Provincial or Federal-Provincial activities.

Certain farm forestry and tree culture projects that are of general public interest can be conducted as specific activities of provincial departments, others may be government sponsored but conducted as activities by municipal councils and farmer organizations, with provincial co-operation. For example, provincial afforestation projects are essentially activities of a provincial department. Highway planting, protection of drainage ditches, and the establishment of recreational areas are activities which would be carried on normally either by provincial departments or by provincial departments in co-operation with municipal councils. The organized establishment of field shelterbelts for soil and water conservation and the general development of farm woodlots are activities in which farmers and farmers' organizations require government co-operation. In this connection administrative policies will have to be formulated and machinery set up to facilitate co-operative action.

In all these activities a co-ordinating provincial farm forestry unit or branch is very desirable in order that all the projects may fit into a well planned provincial pattern. It is also highly desirable that the educational programs of all inspirational agencies should be in the nature of a co-operative approach to secure unified objectives.

The actual work of planting and subsequent care of trees and farm forests need not be dealt with specifically in this report. Such practices are treated adequately in such bulletins as:

(1) "Shelterbelts and the Farm Woodlot," Province of Manitoba, Department of Mines & Natural Resources. Forest Service Bulletin.

(2) "Tree Planting on the Prairies of Manitoba, Saskatchewan and Alberta," Dominion of Canada Department of Agriculture, Pub. 623, Farmers' Bull. 64—Reprint August, 1939.

(3) "How to Plant Hardwood Cuttings," Dominion Department of Agriculture, Pub. 516, Cir. 106.

(4) "Forest Tree Planting," Bull. No. 1. A. H. Richardson, Department of Lands and Forests, Ontario.

(5) "The Farm Woodlot," Reforestation Bull. No. 2, Department of Lands and Forests, Ontario.

(6) "Farm Woodlots in Eastern Canada," E. S. Richard, Associate Committee on Forestry, National Research Council of Canada, Ottawa.

APPENDIX

APPENDIX 1

DOMINION GOVERNMENT EFFORTS TO PROVIDE FOR FARM WOODLOTS DURING THE EARLY DAYS OF SETTLEMENT

(*a*) Extract from—

"Report of Secretary of State of Canada"
(for the year ending on the 30th June, 1872).

Re:

Provision for dividing timbered portions into woodlots:

"To ensure that in any township, the greatest possible numbers of its settlers should benefit alike by such wood as might occur therein, and to prevent its monopoly by the few first comers, who might take up all the best wooded lands, it was provided, in the Dominion Lands Act, that in townships consisting of partly prairie and partly woodland, the timbered portions should be divided into woodlots, varying from 10 to 20 acres in extent, so as to afford as nearly as circumstances would admit, one such woodlot to each farm of 160 acres.

"Had the country been surveyed ere settlement began, these provisions of the Act could have been applied as soon as it was passed. They could not have failed to work well in the carrying out, and would have exactly met one of the first wants of the new settler on prairie land, some certainty as to his source of supply of fuel and fencing material. But at the time of the transfer of the North West Territories to the Dominion, before surveys could have been commenced, the people of the Red River Settlement were cutting large quantities of wood for timber, fencing and fuel, on the wild lands other than their own property. As new settlers taking up prairie locations came in, they followed the existing practice. It was impossible that such irregular procedure could go on without trouble ensuing among the settlers themselves, and the impression arising that the impropriety of general trespass on the public domain was being overlooked by the government. To prevent the lawless appropriation, by a comparatively few individuals, of the choicest timber in the Province, and at the same time to provide for the absolute necessities of the growing population, something had to be done to regulate the cutting of woods without using any arbitrary measures that would tend to check the market supply. The woodlands involved were yet unsurveyed: it was therefore impossible to apply the system provided by the Act. To meet this emergency, and until the completed surveys of the country would admit of carrying out the terms of the Act, a temporary system of permits, under Order in Council was adopted; so arranged as to legalize and regulate all cutting of woods from that of the settlers' fuel for his own wants, up to the supply of logs for the sawmills that furnish lumber to the business centres of the Province.

"A small tax is levied in connection with these permits, not so much as a source of revenue as for the recognition of authority, and acknowledgment of benefit conferred that it involves.

"This system of permits has, the Surveyor General reports, been cheerfully accepted by all concerned, and is now being successfully carried out."

Department of the Secretary of State of Canada,
Ottawa, February 28th, 1873.

(*b*) *Provision for the purchase of woodlots, 1874:*

The first regulations governing the disposal of woodlots are contained in a memorandum attached to Order in Council, dated November 4th, 1874. The system of woodlots in prairie townships permitted homestead settlers, having no timber on their own lands, to purchase woodlots in area not exceeding 20 acres each, at a uniform rate of $5.00 per acre, to be paid in cash.

(*c*) *Provision for land grants as "claims for forest tree planting." Amendment to Dominion Lands Act, 1876:*

Dominion Lands Acts Amended

Chap. 19. 39 Vict.

"20. Any person, male or female, being a subject of Her Majesty by birth or naturalization, and having attained the age of eighteen years shall be entitled to be entered for one-quarter section or less quantity of unappropriated Dominion lands as a claim for forest tree planting.

"21. Application for such entry shall be made in form F, in the schedule hereto, and the person so applying shall make an affidavit before the local agent according to form G, in the schedule hereto, and shall pay at the time of applying an office fee of ten dollars, for which he or she shall receive a receipt and also a certificate of entry, and shall thereupon be entitled to enter into possession of the land.

"22. No patent shall issue for the land so entered until the expiration of six years from the date of entering into possession thereof, and any assignment of such land shall be null and void unless permission to make the same shall have been previously obtained from the Minister of the Interior.

"23. At the expiration of six years the person who obtained the entry, or, if not living, his or her legal representative or assigns shall receive a patent for the land so entered on proof to the satisfaction of the local agent as follows:

"1. That eight acres of the land entered had been broken and prepared for tree planting within one year after entry, an equal quantity during the second year, and 16 additional acres within the third year after such date;

"2. That eight acres of the land entered had been planted with forest trees during the second year, an equal quantity during the third year, and 16 additional acres within four years from the date of entry—the trees so planted being not less than 12 feet apart each way;

"3. That the above area, that is to say, one-fifth of the land has, for the last two years of the term, been planted with timber, and that the latter has been regularly and well cultivated and protected from the time of planting; provided that in cases where the land entered is less in extent than one quarter-section or 160 acres, then the respective areas required to be broken and planted under this and the two next preceding sub-sections shall be proportionately less in extent.

"24. If at any time within the period of six years as above, the claimant fails to do the breaking up or planting or either, as required by this Act, or any part thereof, or fails to cultivate, protect, and keep in good condition such timber, then and upon such event, the land entered shall be liable to forfeiture in the discretion of the Minister of the Interior and may be dealt with in the same manner as homesteads which may have been cancelled for non-compliance with the law as set forth in sub-section sixteen a, inserted in section thirty-three of the 'Dominion Lands Act,' respecting homesteads, by the Act of 1874.

"25. Provided that no person who may have obtained pre-emption entry of a quarter-section of land in addition to his homestead entry under the provisions of sub-section one, of section thirty-three of the said 'Dominion Lands Act,' as amended by the Act of 1874, and by this Act, shall have the right to enter a third quarter-section as a tree planting claim; but such person, if resident upon his homestead, may have the option of changing the pre-emption entry of the quarter-section or of a less quantity of such quarter-section, for one under the foregoing provisions, and on fulfilling the preliminary conditions as to affidavit and fee, may receive a certificate for such quarter-section, or for such quantity thereof as may have been embraced in the application; and thereupon the land included in such change of entry shall become subject in all respects to the provisions of this Act relating to tree planting.

"26. Any person who may have been entered for a tree planting claim under the foregoing provisions, and whose right may not have been forfeited for non-compliance with the conditions thereof, shall have the same rights of possession, and to eject trespassers from the land entered by him, as are given to persons on homesteads under sub-section seventeen a, added by this Act to section thirty-three of the 'Dominion Lands Act,' and the title to land entered for a tree planting claim shall remain in the Government until the issue of a patent therefor, and such land shall not be liable to be taken in execution before the issue of the patent."

It is evident that very few settlers in Manitoba took advantage of acquiring land under this provision, but records show that S.E. 28-3-5 recorded as No. 33 was entered May 9th, 1878, and patented March 12th, 1890. Also N.E. 28-3-5 recorded as No. 34 was entered May 9th, 1878, and patented October 30th, 1889. Approximately 100 claims were filed, but apparently only two are recorded as patented; those not patented were proved up as pre-emptions.

APPENDIX 2

RECORDS OF PIONEER TREE PLANTINGS IN THE MORDEN-RHINELAND DISTRICTS

(a) The following information was supplied by courtesy of Mr. Menno Klassen, Secretary of the Rhineland Agricultural Society:

"According to Mr. Schellenberg the earliest plantings were done by the Old Colony Mennonites in the village of Blumenort, three miles west of Gretna. These settlers arrived in 1875 and it was in 1877 that the first trees were planted. The first plantings consisted mainly of cottonwood and the cuttings were obtained from the woods on the banks of the Pembina River just a mile south of the village of Blumenort.

"Mr. Schellenberg himself planted his first cottonwood in the village of Neuanlage, where he is still located (a mile east of Gretna), in the spring of 1879. However, it was not until 1886 that trees were planted more extensively and in greater variety. Miss Tina Klassen planted ash and boxelder and fruits at that time, and Mr. Schellenberg tells me that one of the finest trees on his yard is one that he planted in 1887. The Pembina River is the source for the planting stocks. Many of these trees are now four feet in diameter and stand from 60 to 80 feet high. Most of the trees planted are still vigorous and in good health."

(b) The following information was supplied through the courtesy of Mr. W. R. Leslie, Superintendent of the Morden Experimental Station, who obtained these historic records through the kindly co-operation of Mr. A. MacAulay, of Morden, and Mr. C. J. Funk, of Winkler:

From notation by A. MacAulay:

"The settlers arrived in 1875. The first plantings were made in 1876 and 1877. Wild trees were taken from the bush, and some trees were planted from seed blown from U.S.A. The plantings included plums, cherries, gooseberries, poplars, ash, maple, etc."

From letter to A. MacAulay, by C. J. Funk:

"I have talked to three old timers, who gave me the following:

"1. Rev. John Warkentin, age 86, retired farmer, arrived by river boat at Emerson in 1879, together with his father, Jacob Warkentin. They settled first on Section 7-1-4, forming a village by the name of Kronsfeld. His father, Jacob Warkentin, planted his first trees there in the first spring after they arrived; balsam poplar, white poplar and the black poplar, as well as wild cherries and plums were taken from the foothills of the Pembina Mountains; the cherries and plums were transplanted seedlings, while poplars were generally planted as cut shoots. The first cottonwood was brought over from North Dakota. Rev. John Warkentin planted his first trees on Section 32-3-4, adjoining the town of Winkler, in 1890. These cottonwood poplars are still standing.

"2. Mr. P. A. Zacharias, age 67, stated that his father-in-law, Jacob Zacharias, 60 years ago planted cottonwood poplars on their homestead in the village of Rhineland; these trees still adorn the village. Wild cherries and plums were obtained from the hills.

"3. Mr. George A. Elias, age 92, of Winkler, retired farmer, still fresh and alert of memory, landed at Niverville on the Red River in 1875, a year before the railroad from Emerson to Winnipeg was built. He stated that the first settlers disembarked at Niverville and built log houses there. In 1876 he moved west of the Red River, where there was open prairie and the trees grew only along the creeks and low places. There were oak as well as several kinds of poplar trees, but the cottonwood was carried over by the wind from the south and came to southern Manitoba from North Dakota. These seeds grew everywhere in moist places where the prairie was dug up and then young trees were transplanted for shelter around the buildings in the villages. Mr. Elias settled on Section 3-1-4, where the village of Greenfeld was formed. All villagers immediately after arrival planted trees in the aforesaid manner. Some had brought seeds of tame fruit trees from the old country, but these were planted without success. Wild fruit trees were found in the hills and transplanted into the village orchards, but tame fruit growing was attempted much later. Mr. Elias produced to me an apple about two inches in diameter grown on a 20 year old tree owned by one of his sons."

Grateful acknowledgement is hereby made to M. Klassen, W. R. Leslie, A. MacAulay, and F. C. Funk for the above historic records.

APPENDIX 3

EARLY RECOGNITION OF THE NEED FOR EXPERIMENTAL FORESTRY STATIONS

Extract from—

Sessional Papers, Vol. XVIII, No. 7, 1885, Forestry Commission.

Part of "Summary of Preliminary Report" of Mr. J. H. Morgan, Commissioner.

"The work to be done is one of great magnitude in which the government, the railroads, the land companies and the people must all take a share. The government should, however, take the initiative, the first and most essential step being the establishment of experimental forestry stations at several points in Manitoba and the North-West Territories. The aim of these stations would be to furnish a scientific as well as practical foundation for a rational management of the forests, to examine the advantages which one method may have over another, and to establish an economical and profitable system of forest administration. Mr. Morgan thinks immediate steps should be taken towards the establishment of these experimental stations, which would be of great benefit to us, and solve many of the problems that otherwise might lead to failure. From these stations could be learned what trees could be grown; their adaptability to the soil; a study could be made of the animal and vegetable foes of trees, and of the means to combat them; while reliable tables of increase could be acquired, as well as practical methods for valuing forests. They could also be used as nurseries for raising and supplying young trees to settlers, and as meteorological stations. Various suggestions are then given as to the selection of sites for these stations, the preparation of land for the planting of shelterbelts around them, the preparation of the soil for the planting of the young trees, and for directing the progress of the work at the different stations when in operation."

APPENDIX 4

FEDERAL DISTRIBUTION OF TREE SEEDS AND SEEDLINGS

(*a*) *Early distribution of trees from Central Experimental Farm, 1889:*
Reference:
"Forest Trees on the Great Western Plains."
Experimental Farms Reports, 1889, pp. 15-16.

"A wise policy has recently been adopted by the Canadian Pacific Railway of setting apart, at each of the more important railway stations through the sparsely settled portions of the western plains, about an acre of land for garden purposes in which are grown a number of different kinds of vegetables, small plots of grain and other products, the whole being brightened by a few flower beds. At the request of the Canadian Pacific Railway officers, a distribution of trees was made from the Central Experimental Farm to 25 of these experimental gardens located at principal points along the line between Moose Jaw and Calgary, a distance of about 440 miles, with the view of testing their relative hardiness and adaptability to this region. Twenty-five bundles were put up and forwarded, each containing 175 trees consisting of the following varieties:

Deciduous Trees

10	Manitoba Maple	Negundo aceroides,
10	American Elm	Ulmus americana,
10	Green Ash	Fraxinus viridis,
10	White Ash	Fraxinus americana,
10	Locust	Robinia Pseudacacia,
10	European Larch	Larix europea,
10	Sugar Maple	Acer saccharinum,
5	Red Maple	Acer rubrum,
5	Soft Maple	Acer dasycarpum,
5	Norway Maple	Acer platanoides,
5	Black Walnut	Juglans nigra,
5	American Beech	Fagus ferruginea,
2	Wild Black Cherry	Prunus serotina,
2	American Mountain Ash	Pyris americana,
2	European Mountain Ash	Pyris acuparia,
2	Yellow Birch	Betula lutea,
2	Canoe Birch	Betula papyracea,
2	Rock Elm	Ulmus racemosa,
2	European Alder	Alnus glutinosa,
2	American Sycamore	Platanus occidentalis,
2	Honey Locust	Gleditschia triacanthos,
5	Russian Mulberry	Morus hybrida,
2	Hardy Catalpa	Catalpa speciosa,
2	Horse Chestnut	Aesculus hippocastaneum,
1	Kentucky Coffee Tree	Gymnocladus canadensis,
1	Ailanthus	Ailanthus glandulosus,
1	Yellow Willow	Salix,
1	Wisconsin Weeping Willow	Salix Wisconsiana (blanda)
1	Tree Cranberry	Viburnum opulus,
4	Barberry	Berberis vulgaris,

Evergreen Trees

10	Scotch Pine	Pinus sylvestris,
10	Norway Spruce	Abies excelsa,
5	Austrian Pine	Pinus austriaca,
5	American Arbor Vitae	Thuya occidentalis,
5	White Spruce	Abies alba
4	White Pine	Pinus strobus.

"To these were added ten currant bushes in five varieties, four raspberry bushes in two varieties, and 50 assorted strawberry plants."

(b) *Tree seed and seedling distributions by Dominion Experimental Farm, Brandon, as shown by extracts from the annual reports of S. A. Bedford, Superintendent, and published in "Experimental Farms Reports," 1889-1903:*

DOMINION EXPERIMENTAL FARMS REPORT, 1889, PAGE 131:

"There is an increased interest manifested in forestry and arboriculture throughout the province. Several thousand ash-leaf maples were planted by farmers in this district last season, and enquiries for tree seed are received from all parts of the North West.

"Early this spring, 12,000 forest trees and shrubs were received from the Central Experimental Farm at Ottawa. This collection consists of 118 varieties.

Seedlings

"During October of last year several bushels of native ash and maple seeds were sown in rows three feet apart. These came up in early spring, but were all destroyed by the wind storm of the 17th and the frost of the 20th of April. Another sowing was made the last week of April. The 6,000 ash and 7,000 maples from this sowing have made good growth and will be available for permanent planting next spring."

DOMINION EXPERIMENTAL FARMS REPORT, 1890, PAGE 266:

"As an experiment, a few native elm seedlings were transplanted from the banks of the Assiniboine River last spring. These are doing well: 33,000 of elm, 4,000 of spruce and 1,500 of buffalo berry seedlings were collected during the fall and heeled in ready for spring distribution and planting.

"Twelve thousand, three hundred native maple and 6,500 ash trees were raised from seed during the past summer. These will be available for planting and distribution during the coming spring."

DOMINION EXPERIMENTAL FARMS REPORT, 1891, PAGES 278-279:

"Seeing the hardiness of the native trees, and realizing the importance of securing a large supply for the purpose of windbreaks and for distribution, a large number of elm and other seedlings were procured in the fall of 1890, and of these 13,000 were sent to the Experimental Farm at Ottawa and Indian Head, and 5,000 were distributed amongst farmers in different parts of the province, in answer to applications from them.

"In the spring of 1891 a further supply of seedlings of birch, spruce, etc., were secured from the bush near here, and, with the remainder of those gathered in the fall of 1890, were planted out in nursery rows. In addition to these, the most hardy and desirable of the Russian poplars and willows have been propagated so as to yield a large supply of cuttings, which, together with the native seedlings mentioned above, will form a stock available for planting and distribution during the coming season.

"Last winter a large number of applications for trees were received from farmers throughout the province.

"In early spring over 20,500 trees and tree-cuttings were distributed by mail. They were sent in packages containing 100 trees, as follows:

Variety	*No.*	*Variety*	*No.*
White Elm, Native	10 trees	Artemisia Abrotans	5 cuttings
Buffalo Berry, Native	2 trees	Populus pyramidalis	1 cutting
Ash-leaf Maple, Native	10 trees	Populus Petrovsky	1 cutting
Green Ash, Native	10 trees	Populus Lindleyana	1 cutting
White Spruce, Native	10 trees	Salix, 122 var.	7 cuttings
Populus Siberica	1 cutting	Willows, Wisconsin Weeping	7 cuttings
Populus Nolestii	1 cutting	Willow, Norway	7 cuttings
Populus Beno	3 cuttings	Willow, Purple	1 cutting
Populus, certinensis	2 cuttings	Willow, Basket	1 cutting
Populus Wobstii Riga	1 cutting	Willow, Golden	1 cutting
Populus bereolinsis	1 cutting	Willow, Yellow	1 cutting
Populus alba argentea	1 cutting	Willow, acutifolia	2 cuttings
Populus, aurea	1 cutting	Willow, Voronesh	5 cuttings
Populus, Bolleana	1 cutting	Northern Cottonwood	6 cuttings"

DOMINION EXPERIMENTAL FARMS REPORT, 1892, PAGE 221:

"The distribution of hardy forest tree seedlings and cuttings from this farm has largely increased during the past year; over 50,000 were applied for; as this number exceeded our supply, applications for 10,000 were held over and will be filled next spring.

"Many favourable reports have been received from parties supplied with trees in 1890, and this branch of the farm work is greatly appreciated, especially by farmers settled on the unsheltered prairies.

"All the trees and cuttings sent out last year were grown on the Experimental Farm and over 50,000 have been prepared for next spring's distribution.

"The packages were sent by mail and contained 100 trees and cuttings, as follows:

Variety	*No.*	*Variety*	*No.*
Ash-leaf Maple	42 trees	Willow laurifolia	1 cutting
Native White Elm	6 trees	Populus bereolensis	7 cuttings
Green Ash	1 tree	Populus Petrovsky	8 cuttings
White Birch	2 trees	Populus certinensis	1 cutting
Artemisia abrotans	3 cuttings	Populus alba argentea	1 cutting
Willow Voronesh	15 cuttings	Populus Wobstii Riga	1 cutting
Willow acutifolia	2 cuttings	Cottonwood	10 cuttings"

DOMINION EXPERIMENTAL FARMS REPORT, 1893, PAGE 267:

"This branch of the farm work increases each year.

"Applications for 59,000 forest tree seedlings and cuttings, 12,000 small fruit cuttings, and 400 one-pound bags of maple seed were received last winter. As the applications for forest trees exceeded our supply, 10,000 of these were sent from the Central Experimental Farm, the balance were supplied from trees grown here.

"Favourable reports are being received of the trees sent out in former years, and in some instances cuttings are already being made from those sent out in 1890.

"One hundred thousand cuttings are being prepared for next year's distribution.

"The packages were sent by mail and each contained 100 trees and cuttings, as follows:

Variety	*No.*	*Variety*	*No.*
Ash-leaf Maple	28 trees	Populus certinensis	1 cutting
Cottonwood	15 cuttings	Populus alba argentea	1 cutting
Artemisia abrotanum	10 cuttings	Populus Wobstii Riga	1 cutting
Native White Elm	10 trees	Willow Voronesh	10 cuttings
Populus bereolensis	4 cuttings	Willow acutifolia	10 cuttings"
Populus Petrovsky	10 cuttings		

DOMINION EXPERIMENTAL FARMS REPORT, 1894, PAGES 318-319:

"Four hundred and sixty-eight packages of forest trees were sent out from this farm during the year; the trees supplied were of the same varieties as those sent out last year, a list of which will be found on page 267 of last year's report.

"In addition to the above, 175 packages of small fruits were also mailed to farmers throughout the province.

"Circulars were sent to the parties receiving trees, asking for a report of their success or otherwise; these particulars will be compiled and will, no doubt, prove a useful guide in future distributions.

"Three hundred and fifty one-pound packages of native ash-leaf maple seeds were distributed throughout the province, principally to farmers; reports regarding these are coming in daily, and evidently this is one of the best means of encouraging tree growing undertaken by the Experimental Farms."

DOMINION EXPERIMENTAL FARMS REPORT, 1895, PAGE 314:

"The distribution of forest tree seedlings and cuttings has been continued, 291 parcels, each containing 100 cuttings, were sent out during the year; these were nearly all varieties of Russian poplars and willows which are hardy here.

"Ninety collections of rooted trees were also sent to individuals and public institutions, who were willing to pay the express charges on them.

"Since my last report, the circulars sent out with the tree distribution in 1894 have been returned and their contents compiled.

"From the accompanying summary it will be seen that the parties receiving trees have had fair success for such an exceptionally dry year; the results of the distribution of 1895 will probably be still more satisfactory, as the season has been a favourable one.

"A number of farmers are already growing young trees for themselves and neighbors by means of cuttings, taken from the poplars and willows distributed in former years, and thus the usefulness of this good work is being extended.

Analysis of Tree Reports

Number of reports received	143
Number reported as having received the parcels in good condition	89
Number reported as having received the parcels in fair condition	24
Number reported as having received the parcels in bad condition	17
Number reported as having had good success with the trees	95
Number reported as having had fair success with the trees	20
Number reported as having had poor success with the trees	28

Distribution of Tree Seeds

"Two hundred and twenty-six one-pound packages of Manitoba maple tree seeds were distributed during 1895, and from the few reports already received it is evident that the season has been a favourable one for the seedlings.

"The following summary has been compiled from the reports received from the tree seed distribution of 1894. Although the summer of 1894 was unfavourable for the germination of tree seeds, it will be seen that the average number grown from a pound package of seed was 847; the particulars given show the advantage of thoroughly cultivating the land before sowing the seed.

Tree Seed Distribution

Number of reports received	72
Number of favourable reports	56
Number of unfavourable reports	13
Number of failures from dry weather	11
Number of failures due to injury from cut worm	1
Average height of seedlings in the fall (inches)	12
Average number of seedlings from one pound of seed	847

Best Results Obtained by the Most Careful Growers

Number of Seedlings from One Pound of Seed	How Land Was Prepared	When Sown	Height in Fall (Inches)
5,000	New land fallowed	May 15	6–18
3,000	Garden land	May 12	6–15
2,745	Potato land	May 10	31
3,000	Cattle corral	June 1	24
2,200	Well cultivated	May 9	12

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DOMINION EXPERIMENTAL FARMS REPORT, 1896, PAGE 363:

Boxelder Tree Seed

"A large number of applications for tree seeds were received during the year, but owing to the complete failure of the crop in 1895 none could be had for distribution.

"The crop of seed was a large one this year and 800 pounds were gathered from the trees planted on this farm in 1890-91; these will be available for distribution during the coming year. They are sent out in bags by mail, containing about one pound each.

Forest Tree Distribution

"This branch of the work is very much appreciated by settlers living in the open prairie parts of the province. The number of packages sent out last season was larger than in any previous year, viz.: 777 packages containing from 50 to 100 trees or cuttings in each package. Judging from the reports received, an intelligent interest in tree culture is increasing rapidly among farmers; the reports this year showing that a much larger number than usual have succeeded with the trees.

Analysis of Tree Reports

Number of packages sent out	777
Number of reports received	405
Number reported as having received parcels in good condition	345
Number reported as having received parcels in fair condition	1
Number reported as having received parcels in poor condition	22
Number reported as having had good success with trees	388
Number reported as having had fair success with trees	13
Number reported as having had poor success with trees	4

DOMINION EXPERIMENTAL FARMS REPORT, 1897, PAGE 343:

Notes on Tree Seeds

Number of packages of trees distributed	906
Number of reports received	81
Number of packages received in good condition	74
Number of packages received in fair condition	2
Number of packages received in poor condition	5
Number reported to have had good success	71
Number reported to have had fair success	10
Number reported to have had failures	0

Maple Seed Distribution

Number of packages sent	385
Number of reports received	99
Number reported as very successful	58
Number reported as fairly successful	30
Number reported as failures	11

DOMINION EXPERIMENTAL FARMS REPORT, 1898, PAGE 313:

Distribution of Tree Cuttings

"In accordance with instructions received from the Director last spring, 25,000 cuttings of cottonwood, Russian poplar and willows were prepared and mailed to applicants. Although instructions for this work were received rather late in the season for the best results, we were able to supply all applicants with a package containing 100 cuttings, which was generally made up as follows: 25 cottonwood, 25 Russian poplar, 25 sharp-leaved willow, and 25 Voronesh willow.

"From reports received we learn that very few of the willows failed, a number of the Russian poplars struck, but poor success was had with the cottonwoods, the spring evidently being too dry to permit of the rooting of the wood of this moisture-loving tree.

"On this farm cottonwood cuttings made and planted deeply in fallowed land as soon as the ground is thawed out in the spring have generally rooted well, but when cut late in the spring, or planted on spring plowed stubble, they have nearly always failed.

"The total number of applicants supplied with tree seedlings and cuttings during the year was 1,237, which is 331 more than last year."

DOMINION EXPERIMENTAL FARMS REPORT, 1899, PAGE 321:

Distribution of Poplars and Willows

"Under the instructions from the Director, many thousands of cottonwood, poplar and willow cuttings were prepared and planted during the past year for the purpose of distribution as soon as they became established. This was deemed advisable, owing to the want of success among farmers generally in striking the cuttings which have hitherto been distributed to them. In preparing and planting these cuttings it was thought well to test several different methods. Some cuttings were taken in the usual way, namely 9 inches long, cut carefully above a bud at the top, and below a bud at the bottom, with all side shoots trimmed off. Others were cut, leaving the terminal bud intact and many of the small shoots left on. Others again were cut in the shape of what is technically called mallet or heel cuttings. This is a shoot 9 inches long with a heel of older wood about 3 inches long."

DOMINION EXPERIMENTAL FARMS REPORT, 1900, PAGE 372:

Forest Trees and Shrubs

"The effects of the past unfavorable season were visible in this division, as well as in other branches of farm work. Though the well-established trees do not show bad results in a marked degree, seedlings, cuttings, and newly-transplanted specimens were more or less adversely affected by the long-continued drought of the spring months. A much larger percentage of transplanted trees succumbed during the past year than has been recorded for some time, while the germination of seedlings, and the growth of cuttings, were almost failures: not more than 10 per cent. of the former, and less than 5 per cent. of the latter, starting to grow. The avenue trees and large hedges, however, looked quite as well as usual, and though much damage from insect pests was reported in the immediate vicinity to trees of the same varieties of which these are composed, we are pleased to be able to report perfect immunity from this trouble. Taken altogether, the season was a very unfavorable one for this branch of work."

DOMINION EXPERIMENTAL FARMS REPORT, 1901, PAGES 452-453:

Boxelder or Manitoba Maple Seeds

"The following reports have been received from parties to whom Manitoba maple seeds were sent in one-pound packages during the spring of 1900:

Number of applicants supplied	240
Number of reports received	89

	Success	Failure
Seeds sown on summer fallow	3	12
Seeds sown on spring plowing	20	6
Seeds sown on fall plowing	22	11
Seeds sown on breaking	9	3
Seeds sown on garden (dug with spade)	3	..

Largest number of plants raised from one-pound packet	2,000
Maximum height of seedlings at end of season (feet)	2.5

Distribution of Collections of Trees, Spring of 1900

"Only 8 per cent. of parties supplied with trees reported having received the packages in good condition.

Number of applicants supplied	525
Number of reports received	43

Average Per Cent. of Cuttings Struck	Per Cent.
Russian Poplars	20
Cottonwoods	34
Willows	13

Maximum Growth, Summer 1900	Feet
Russian Poplar	4
Cottonwood	3
Willows	3

Propagation of Trees for Distribution

"Caraganas, Russian poplars, elms, and willows, were grown for free distribution. The caraganas were propagated from seed. The seed was sown the same as garden peas, in rows 30 inches apart, about one inch deep and about one inch apart in the rows. Fresh gathered elm seed was sown in shallow drills 12 inches apart and covered with fine soil by means of a garden rake.

Propagation of Trees for the Forestry Branch of the Department of the Interior

"Under your instructions some ten acres of land was set apart for the growing of trees for the above department.

"The principal part of these were native ash-leaved maples, grown from seed, but a number of elms and willows were also grown.

"The maple seed was sown in drills three feet apart, the seeds touching each other in the row. Most of the seed was soaked before sowing. In some instances the seed was plowed under, by striking out a furrow three inches deep and placing the seed at the bottom of the furrow, and plowing a second furrow over it. Adjoining rows were struck out with a Planet Junior drill two inches deep, and the seed sown by hand and the soil filled in with a rake. The rows covered with a plow produced 160 trees to the chain of row, and the rows filled in with the rake 733 trees to the chain. Either the plowing was too deep, or else the soil when thrown in with the plow was too hard and lumpy for the best results. Altogether, 110,000 maples and elms were grown from seed, and in addition, seedling elms were collected from the natural bluffs by the river side."

DOMINION EXPERIMENTAL FARMS REPORT, 1902, PAGE 308:

Propagation of Trees and Shrubs for Distribution

"An increased number of trees and shrubs have been grown for free distribution. In most cases the seed or cuttings have been grown on the Experimental Farm. The seed of the larger trees and shrubs was sown in the open field, in drills three feet apart. The smaller shrubs were grown in seed beds and the drills made one foot apart. The following list includes most of the varieties grown: native ash-leaf maple, caragana, bush honeysuckle, sand cherries, lilacs.

Propagation of Trees for the Forestry Branch of the Department of the Interior

"The 110,000 trees grown here for the above department were distributed last spring, and I understand have given very general satisfaction. This year a much larger area was sown with various tree seeds, and the following list gives the number of trees raised from seed. These are nearly all large enough for distribution next spring.

Ash-leaf Maple (Native)	512,000
Green Ash	310,000
White Elm	50,000
	872,000

DOMINION EXPERIMENTAL FARMS REPORT, 1903, PAGE 351:

Propagation of Trees for the Forestry Branch of the Department of the Interior

"All the 872,000 trees grown here in 1902 for the above department were distributed this spring to farmers in different parts of the province, and the percentage of loss, I understand, was very small.

"About one million and a half trees were grown here this year for future distribution by the Forestry Branch, nearly all the young trees were dug in the fall and heeled in ready for spring shipping."

(c) *Tree seedlings distributed in Manitoba from Indian Head Forest Nursery, 1901-1944. This Dominion Government Nursery was operated by the Department of the Interior from 1901 to 1930. From 1930 it has been operated by the Experimental Farms Branch.*

TABLE NO. 7—RECORD BY NUMBER AND VARIETIES OF TREES DISTRIBUTED FOR FARMSTEAD SHELTERBELTS IN THE PROVINCE OF MANITOBA, UNDER DOMINION GOVERNMENT TREE PLANTING POLICY

(Data supplied by courtesy of J. Walker, Superintendent Dominion Forest Nursery Station, Indian Head, Sask.)

Variety	5-Year Periods								4 Years	Total Number
	1901–1905	1906–1910	1911–1915	1916–1920	1921–1925	1926–1930	1931–1935	1936–1940	1941–1944	
BROAD LEAFED:										
Manitoba Maple	1,160,975	1,452,370	605,900	627,575	719,675	1,049,825	601,765	740,410	515,500	7,473,995
Green Ash	610,000	649,425	361,500	399,450	354,805	473,525	445,250	615,050	333,700	4,242,705
White Elm	330,700	184,575	17,775	....	....	5,475	86,425	321,375	214,850	1,161,175
Cottonwood	214,800	144,100	55,575	....	1,200	150	1,320	725	8,725	426,595
Russian Poplar	66,000	176,600	58,175	276,800	577,500	395,250	145,675	14,000	4,050	1,714,050
Acute Willow	80,000	392,400	377,225	263,300	212,425	306,800	177,600	179,275	178,400	2,167,425
Poplar Hybrids	....	....	....	....	....	68,225	40,625	109,150	65,700	283,700
Laurel Willow	....	....	....	3,000	290,000	279,300	45,250	57,775	21,350	696,675
Red Willow	....	....	....	107,900	165,275	5,575	....	....	....	278,750
Birch	....	1,000	....	....	....	1,650	....	....	....	2,650
Caragana	....	3,225	35,625	245,550	713,275	1,320,170	1,266,200	3,426,225	1,971,810	8,982,080
Total	2,462,475	3,003,695	1,511,775	1,923,575	3,034,155	3,905,945	2,810,110	5,463,985	3,314,085	27,429,800
Average per Year	492,495	600,740	302,350	384,715	606,830	781,190	562,022	1,092,790	828,521	....
CONIFERS:										
Siberian Larch	....	....	1,050	....	....	....	810	....	....	1,860
Tamarack	....	8,950	6,000	....	....	....	....	....	....	14,950
Scots Pine	....	4,525	8,300	16,200	21,400	28,750	29,835	27,814	22,900	159,724
Jack Pine	....	350	8,700	22,700	12,250	6,100	....	....	....	50,100
Lodgepole Pine	....	....	12,150	10,200	100	1,400	....	....	....	23,850
White Spruce	....	225	23,100	53,500	17,800	18,325	72,995	79,601	71,649	337,195
Colorado Spruce	....	38	1,125	....	....	....	....	18,515	53,458	73,136
Norway Spruce	....	700	7,700	....	....	....	....	....	....	8,400
Total	....	14,788	68,125	102,600	51,550	54,575	103,640	125,930	148,007	669,215
Average per Year	....	2,970	13,625	20,520	10,310	10,915	20,728	25,186	37,002	....

NOTE The Lyleton Field Shelterbelt Project accounts for the increased distribution of caragana during the 1936-1940 period.

APPENDIX 5

SUMMARY OF THE LYLETON FIELD SHELTERBELT ASSOCIATION ESTABLISHED AS A PRAIRIE FARM REHABILITATION ENTERPRISE

The following information was prepared by J. Walker, Superintendent, Forest Nursery Station, Indian Head, Sask., 1944.

"The Lyleton Field Shelterbelt Association has a membership of 48. In the early years of the project the membership was somewhat higher. This association comprises an area of 42 square miles situated in sections 7-16, Township 1, Range 28, and sections 1-12, Township 2, Range 28.

"To date a total of 1,552,916 trees have been planted in the area, to give a total of approximately 245 miles. Of these, 389,300 trees have been set out as replacements.

"For the past number of years the number of planters each year has averaged about 50. Of recent years also, the amount of new planting has not been great. For the years 1941-43, trees allotted for new planting have totalled 14,225 as against 99,675 for replacements. This indicates that the number of field shelterbelts actually needed in the area have been planted (at least by interested planters), and that planters are concentrating on keeping their hedges fully planted.

"In the Lyleton project hedges are planted closer together than in the Conquest project, namely from 20 to 40 rods apart. However, the narrower distance between them is considered desirable in the Lyleton project because of the generally lighter soil found there as compared with Conquest, Saskatchewan.

"Trees used have included maple, elm, ash and caragana, the latter becoming somewhat unpopular during the thirties when grasshoppers and blister beetles damaged them severely. Since 1942, however, when less damage by these insects has been caused, caragana has returned to popularity.

"The majority are one variety hedges comprising one row. On some farms, however, two rows have been planted, while in others a maple, elm or ash tree has been substituted for every eighth, tenth or twelfth caragana in the single row. The object is to obtain greater heighth than is possible from caragana alone. The single row can also be kept free of weeds more easily than is the case with two or more rows.

"There are also some quite good field shelters of maple and ash alone, and in low areas willow is succeeding very well throughout the project.

"In the matter of direction in which the hedges are planted, whether north and south or east and west, this is governed to some extent by the exact nature of the farm, whether it is longest north and south or east and west, on the location of buildings and the slope of the land. Usually the hedges are planted north and south if the land slopes to the west, and on northern slopes they are usually planted east and west."

APPENDIX 6

FARM WOODLOT AND SHELTERBELT ACTIVITIES BY CANADIAN PROVINCES

The following information was supplied through the courtesy of the respective provincial officials. Grateful acknowledgment is here made for the co-operation and assistance given by these respective officials in this regard.

(*a*) *British Columbia:*

Information by courtesy of F. S. McKinnon, Forester, British Columbia Department of Lands.

"As one might expect in the case of a region which has been settled during relatively recent years, forest practice in British Columbia is still primarily in the category of liquidation of the mature and over-mature forest values. Gradually the logging operations are being pushed back farther and farther from the centres of population and the older farming communities. At the same time the sources of supply for readily accessible fuel wood, fence posts, poles, etc., that can be harvested by one or two men with a team are disappearing. This trend is causing farmers in the more highly developed agricultural districts such as the fertile Lower Fraser Valley, to look at the forested portions of their holdings. Gradually there is developing a realization that the woodlots of eastern Canada and the United States will have a counterpart in British Columbia.

"At the present time there are only isolated instances of woodlot management, but interest is growing and the Forestry Branch is encouraging this interest. Planting stock is distributed free of charge to those wishing to establish or rehabilitate a woodlot. Advice is given when requested, as for example, when plans of management were drawn up for the wooded portions of Prince of Wales Fairbridge Farms property. In addition there have been reserved suitable areas of Crown land on Vancouver Island and through the Lower Fraser Valley which will be used as demonstration woodlots. Lack of personnel has prevented any development of these areas, but there is no doubt that after hostilities cease this phase of forestry will be given considerable attention.

"An allied phase of this subject is the attempt to place Christmas tree cutting in the East Kootenay region of the Interior on a sustained yield basis. The aim of the Forestry Branch is to grant, subject to compliance with the regulations, a semi-perpetual permit to cut Christmas trees over a given area. The areas are laid out on the basis that the acreage will produce in perpetuity about 5,000 trees per year and as long as the permittee conducts his operation satisfactorily his permit will be renewed. Permits are confined to bona fide settlers, and it is hoped that this type of permit will give the cutter a proprietory interest in the forest in which he is working. In this particular region Douglas fir is suitable for little else than Christmas trees and the cash income from such operations occupies an important place in the farm economy.

"As indicated above, such woodlot management as is carried out in British Columbia is done by forest officers from the Forest Service working under authority of the 'Forest Act.' " F. S. McKinnon, Forester. March 13, 1945.

See also—"Report of Commissioner,"
relating to
"The Forest Resources of British Columbia."

Public Inquiries Act, B.C. King's Printer,
Victoria, B.C. pp. 1-195 (1945).

(*b*) *Alberta:*

Information by courtesy of T. F. Blefgen, Director of Forestry, Alberta Dept. of Lands and Mines.

"In reply I wish to say, that we have been giving the farmers in this province every encouragement for the establishment of woodlots by furnishing trees to improve their existing stands.

"These trees are in quite an extensive variety and are sent out free of charge, the recipient only being required to pay the express from the shipping point.

"Advantage has been taken in a great number of cases and we have reports from different parties, some of whom have sent pictures showing the improvements that have been made as a result of their planting.

"This work, however, has fallen off during the last several years, as a number of farmers contend that owing to shortage of labour they are not able to devote the time to planting that they desire to do.

"The results that have been obtained, however, in different localities, are a very good example to others and from enquiries received, it is my opinion that this type of planting will increase once the present labour shortage is alleviated."
Edmonton, March 17, 1945.

(*c*) *Saskatchewan:*

(1) Information by courtesy of E. H. Roberts, Director of Forestry, Saskatchewan Dept. of Natural Resources.

"To my knowledge there are no provincial acts or regulations in this province whereby assistance may be given to farmers or others to encourage the establishment or preservation of woodlots or shelterbelts on farm lands. I am not aware of any reference to such projects in any of our acts.

"The Tree Planting Division of the Dominion Department of Agriculture at Indian Head has sponsored field shelters and has carried on some of this work for several years under the Prairie Farm Rehabilitation Act. Mr. John Walker can, no doubt, give you a report on this.

"The Canadian Forestry Association during their Tree Planting Tours have encouraged such projects in their publicity.

"In my opinion, an extension forester attached to the Agricultural Faculty of the Provincial University should be engaged for this work in co-operation with the Provincial Department of Agriculture."

Regina, March 12th, 1945.

(2) Information by courtesy of J. E. Park, Landscape Architect, Saskatchewan Dept. of Public Works.

"The Saskatchewan Department of Public Works has contributed to the establishment of shelterbelts by excellent demonstrations at all institutional farms and by landscaping all public buildings in the province. This department has also provided quantities of caragana seedlings for farm planting."

(*d*) *Manitoba:*

Information by courtesy of J. G. Somers, Provincial Forester, Forest Service, Manitoba Department of Mines and Natural Resources.

"Work done in Manitoba along these lines may be briefly summarized as follows:

"1. The distribution of planting stock for farmstead and field shelterbelts has been done in the past by the Dominion Government, first from the Experimental Farm at Brandon and later the Tree Planting Stations at Indian Head and Sutherland, Saskatchewan.

"2. The earliest private woodlots artificially established in Manitoba were those on the farm of M. J. Stevenson, near Morris. The main planting was done in the years 1902 and 1906. Some of this material, mainly spruce, is now approaching saw-log size. This plantation is now successfully reproducing itself in a narrow strip along the north side. There are one or two other more recent plantations in this vicinity, one of which is green ash. I am not aware of any other such plantations, established by private parties in Manitoba.

"3. A few farmers have handled existing naturally established woodlots on a proper silvicultural basis. This has consisted of:

(a) Guarding against fire;
(b) Fencing out stock;
(c) Where the timber is poplar, this is cut at maturity, between 30 and 50 years on a clear-cut system, rotating the annual cutting area so that an equal area is cut each year.

"In the case of oak, ash and elm, mainly along the rivers, a selection system has been used, the older material being removed from over the whole woodlot area each year or every few years.

"In both the above systems reproduction has usually been successfully established either by root-suckers in the case of poplar or by seed and coppice shoots from the stumps in the case of oak, ash and elm.

"4. The Provincial Department of Public Works have been planting hedges, on the windward side of main highways from the year 1937 to the present time. Most of the material has been caragana, but other species, such as willow and lilac have been used locally. The material has been for the most part obtained from the Dominion Tree Planting Stations at Indian Head.

"5. An Economic Survey Board was set up by the Provincial Government in 1937, to investigate various phases of the provincial economy. One of the reports issued by this board was entitled 'Agricultural Income and Rural Municipal Government in Manitoba,' and was presented in March, 1939.

"This report dealt with the financial standing and prospects of 111 rural municipalities. One of the points brought out was that 1,000,000 acres of private land had reverted to the municipalities as a result of non-payment of taxes. There was a further area of Crown Lands within the municipalities amounting to 1,500,000 acres, part of this being Forest Reserve, part National Park, but mainly unsold Crown Lands.

"The municipalities were circularized by the writers of the report, re the suggested use which should be made of the tax-reverted lands. No less than 33 of the municipalities were of the opinion that all or part of their tax-reverted land should be devoted to forestry, woodlots or game preserves.

"None of the municipalities at that time or up to the present time have advanced any plan for establishing municipal forests or giving aid to private owners to assist in establishing or developing woodlots. All seemed to look to the Government for a lead. Several of the municipalities have offered to turn over these lands to the Provincial Government as a free gift, in order to escape the burden of keeping up local improvements in these districts.

"Since the report was issued some adjustment has been made. The Provincial Government has purchased all the tax-reverted lands in one municipality and in other cases negotiations are under way by which the Provincial Government will take over such land, either as a gift, or at a nominal rate per acre.

"In general the question still remains open, and will be one of our most important post-war problems. Consideration is being given to the alternative of establishing new forest and game reserves, establishing municipal forests and assisting private owners to practise farm forestry on lands not suitable for agriculture.

"6. The Manitoba Soil Survey has been established and has made good progress in mapping the soils of southern Manitoba. This organization is financed by the Dominion Department of Agriculture, and by the Provincial Department of Agriculture, in co-operation with the Soils Division of the University of Manitoba.

"Valuable reports have been published and other reports are ready for publication. These reports make definite recommendations as to the best use to which lands can be put. These recommendations will be of fundamental value to private owners, to municipalities and to governments in determining future policies re encouragement of owners to establish farm woodlots, municipal forests or provincial forests, as the case may be.

"7. The Provincial Department of Agriculture has an Extension Service. While the main activity of this service has been in giving advice and assistance to farmers in livestock and field husbandry, etc., a certain amount of help has been given in tree planting, more particularly re decorative shrubbery and fruit trees. The Extension Service have agricultural representatives stationed throughout the well settled districts, and this is one agency through which an interest in shelterbelts and farm woodlots may be promoted, and assistance given.

"8. The Forest Service of the Department of Mines and Natural Resources published in 1938 an illustrated bulletin entitled, 'Shelterbelts and Farm Woodlots.' The number printed was 10,000, and distribution was made throughout the province, special attention being given to municipal officials and schools.

"While the Forest Service has no Extension Service, a certain amount of advice is given to private parties interested in tree planting.

"Plantations of Scots pine, jack pine, lodgepole pine, and white spruce were established, starting in 1934, at a point immediately adjacent to the Trans-Canada Highway. These will serve as demonstration woodlots. Earlier plantations, dating back to 1904, are not situated so as to be easily accessible to the public.

"9. The Department of Education, assisted by the Forest Service, in 1934, published an illustrated bulletin on 'Tree Planting on School Grounds.' This bulletin was distributed to all schools in Manitoba, over 2,000 in number."

March 24, 1945.

(*e*) *Ontario:*

Information by courtesy of F. A. MacDougall, Deputy Minister of Lands and Forests, Ontario.

(1) LETTER:

"The subject-matter referred to (i.e., Farm Woodlots and Shelterbelts), is part of the Reforestation Division. Under this section is handled:

"1. Aid to farmers by giving them—

a. Free trees for shelter belts or for plantings,

b. Provide them with free advice on the management of their wood lots.

"2. Aid to counties—

a. The province enters into a co-operative agreement with counties, whereby the counties purchase land and the province plants and manages the property under a thirty-year agreement. At the end of thirty years either party may purchase the others' interest, or a new agreement may be provided.

"3. Zone foresters—

Southern Ontario is divided into zones, supervised by zone foresters. Each zone forester has a district consisting of several counties and works in close co-operation with the agricultural representative."

Toronto, March 14, 1945.

(2) (32) 2ND SESSION, 21ST LEGISLATURE, ONTARIO, 9 GEORGE VI, 1945:

BILL

AN ACT TO AMEND THE COUNTIES REFORESTATION ACT

"His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

Rev. Stat., c. 323, title amended.

1. The title of *The Counties Reforestation Act* is amended by striking out the word 'Counties' and inserting in lieu thereof the word 'Municipal,' so that the said title shall now read as follows:

THE MUNICIPAL REFORESTATION ACT

Rev. Stat., c. 323, s. 3, subs. 1, amended.

2. Subsection 1 of section 3 of *The Counties Reforestation Act* is amended by striking out the words 'in districts without county organization' in the first and second lines, so that the said subsection shall now read as follows:

Powers of certain township councils.

(1) Municipal councils of townships shall have all the powers, privileges and authority conferred by clauses a, b and c of section 1 on councils of counties.

1939, c. 11 amended.

3. *The Counties Reforestation Amendment Act, 1939*, is amended by striking out the word 'Counties' where it occurs in the long title and the short title and in the first line of section 1 of the said Act and inserting in lieu thereof the word 'Municipal.'

Short title.

4. This Act may be cited as *The Municipal Reforestation Amendment Act, 1945*."

EXPLANATORY NOTE The authority now vested in townships in districts without county organization with respect to reforestation projects is extended to all townships and the name of the Act is rendered more accurate.

(3) THE COUNTIES REFORESTATION ACT. CHAPTER 323:

R.S.O. 1937, page 4205.

1. The municipal council of a county may pass by-laws:
   - (a) for acquiring by purchase, lease or otherwise such land designated in the by-law as the council may deem suitable for reforestation purposes;
   - (b) for planting land so acquired and for preserving and protecting the timber thereon;
   - (c) for the management of such land and the sale or other disposal of the timber grown thereon;
   - (d) for the issuing of debentures from time to time for the purpose of providing for the purchase of such land to an amount not exceeding $25,000 to be owing at any one time;
   - (e) for entering into agreements for developing, protecting, caring for, and managing such lands or any portion thereof;
   - (f) for leasing, selling, or otherwise disposing of such lands or any portion thereof. R.S.O. 1927, c. 289, s. 1.

2. No by-law shall be finally passed under this Act until the same shall have been approved in writing by the Minister of Lands and Forests. R.S.O. 1927, c. 289, s. 2.

3. (1) Municipal councils of townships in districts without county organization shall have all the powers, privileges and authority conferred by clauses a, b and c of section 1 on councils of counties.

(2) The councils of such townships shall have power and authority to levy by special rate a sum not exceeding $200 in any year for the purpose of providing for the purchase of such lands. R.S.O. 1927, c. 289, s. 3.

(4) AN ACT TO AMEND THE COUNTIES REFORESTATION ACT:

Statutes of Ontario, 1939, Chapter 11, P. 99.

Assented to April 27th, 1939.
Session prorogued April 27th, 1939.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. The Counties Reforestation Act is amended by adding thereto the following section:
   4. (1) The municipal council of any township may enter into agreements with the owners of lands located in such township providing for—
      (a) the reforestation of portions of such lands;
      (b) the entry and planting of trees upon such portions by the servants or agents of the council; and
      (c) the fencing of such portions and conservation of all growing trees thereon by the owner.
   (2) No such agreement shall provide for the reforestation of less than five acres of land for every one hundred acres belonging to the same owner.
   (3) Every such agreement shall prescribe the conditions under which the cutting of timber upon such portions may be carried out and such conditions shall be subject to the approval of the Minister of Lands and Forests.
   (4) The council of the township may exempt any such portion from general taxation as long as it continues to be used for the purposes set out in the agreement.
   (5) The council of the township may enter into agreements with the Minister of Labour for Canada and the Minister of Labour for Ontario, regulating the conditions of labour performed in connection with the planting and conservation of trees in such portions.
2. This Act may be cited as The Counties Reforestation Amendment Act, 1939.

(*f*) *Quebec:*

Information by courtesy of Roch Delisle, Forest Extension Director.

"In the Province of Quebec, the privately-owned forests cover an area of 26,600 square miles. These forests are in the hands of small, medium and large owners. Conventionally, we consider as a large owner, the one who holds 2,000 acres and more of forested lands, whilst the medium one owns from 300 to 2,000 acres, and the small one less than 300 acres.

"Considering it was highly important that privately-owned woodlands be properly managed, considering also that the large owners were in a position to afford the cost of technical services, the Department of Lands and Forests created by the order-in-council No. 1368 of June 11th, 1942, the Bureau de Rensiegnements Forestiers (Forest Extension Bureau) for the benefit of our 200,000 small and medium owners whose woodlands cover in aggregate 16,600 square miles. Two-thirds of these proprietors are farmers and settlers. The area in farm woodlands is close to 10,000 square miles.

"The Forest Extension Bureau, which is a branch of the Forest Service, has to promote the proper management of small and medium owners' woodlands; to supply these owners with the technical guidance they might want for tending in the proper manner their woodlots and sugar bushes; to help them in the marketing of their forest products. The technical advice given by the extension forester is free of charge."

March 15th, 1945.

(*g*) *New Brunswick:*

Information by courtesy of K. B. Brown, University of New Brunswick, Fredericton, N.B.

"You probably know that conditions here are such that we are not concerned with shelterbelts. Practically the whole area of the province was originally covered with forest except for some swamps, peat bogs, and wild medows. In spite of the fact that settlement has been going on for more than two hundred years, only about 10 per cent of the land area is under cultivation. If cultivation is discontinued, tree cover usually returns to the land in a comparatively short period. Bushes and trees grow up quickly along fences which are established for any length of time.

"We are, however, much interested in farm woodlots. These make up about two and one-half million acres or about 16 per cent of our total forest area, and produce more than a proportional share of the wood taken from our forests. A little over two years ago the province decided to begin the organization of a forestry extension service, but were unable to locate a man to take on the job. It was decided that the work could best be done from the University of New Brunswick in conjunction with the Forestry School. I was asked to undertake the work as an extra job and to go ahead with organization, looking toward the establishment of an extension service as soon as foresters became available. That situation still exists, and although we have made a little progress, it is far from satisfactory.

"The problem as we see it should be approached from two ways: One through improving markets and marketing methods and advice to the farmers on this angle, the other in connection with cutting methods in the forest.

"The Province of New Brunswick operated a forest nursery on a small scale between 1923 and 1933, but there was at that time little demand for trees for planting and the operation of the nursery was discontinued. I hope that we will be able to get under way again to supply planting stock, for its educational value as much as for any other reason. The problem of reforestation in New Brunswick is much less important than that of the cutting methods in existing forests, but the interest in forestry aroused by planting trees is highly beneficial.

"The Dominion Forest Service is co-operating with the Experimental Farms of the Department of Agriculture to set up demonstration woodlots on the Experimental Farms and Illustration Stations. They have also undertaken, temporarily, to do a limited amount of work in lectures and publicity in connection with farm woodlot management. It is expected that the lecturing and publicity will be taken over by the Extension Service of the province, operated through the University of New Brunswick, when this service is established on an operating basis."
April 3, 1945.

(*h*) *Nova Scotia:*

Information by courtesy of G. W. I. Creighton, Provincial Forester.

"For your information I would say that in this province shelterbelts are of little or no importance, since about 80 per cent. of the province bears natural tree growth. Throughout the Annapolis Valley and some other sections windbreaks are planted to give protection to orchards or other farm crops, but the matter is left entirely in the hands of the individual farmer.

"Our department owns a forest tree nursery, and quite often we supply trees for windbreaks on request. Trees for such purposes are supplied by us free of charge. We also help out any individual farmer who asks for assistance in managing his farm woodlot."
April 4th, 1945.

(*i*) *Prince Edward Island:*

Information by courtesy of W. R. Shaw, Department of Agriculture, Prince Edward Island.

"Regarding shelterbelts and farm woodlots in the province of Prince Edward Island, very little work has been done in this connection here. A few years ago we undertook some demonstrational work in the matter of farm woodlots, which created quite a lot of interest in woodlot management and improvement. Unfortunately, after the war broke out, this work was discontinued, and since that time very little in the way of even educational work has been carried into effect.

"At the present time a Reconstruction Committee is at work, and forestry is one of the items that the committee will deal with."
March 15th, 1945.

APPENDIX 7

FARM FORESTRY IN THE EASTERN UNITED STATES,* MINNESOTA AND THE DAKOTAS

Summarized by F. W. Brodrick

The following is a brief summary of the important legislation enacted, the organization developed, and some of the results obtained by these enactments in attempts to put woodlot management on a satisfactory basis.

(*a*) *Farm Forestry in Eastern United States**:

One hundred and eighty-five million acres of farm woodland are located east of the Mississippi in Eastern United States. This is an immense region where attempts are being made to employ the principles of good forest management in the development of the forested area on the farms of that region.

The Federal and State Governments in the United States have given encouragement to the development of farm forestry and to forest tree planting, by passing various Federal and State enactments, and through the encouragement given by various governmental agencies which had as their objective the development of agriculture and farm forestry.

One of the first important enactments in this connection in United States was the Timber Culture Act, passed on March 3rd, 1873, amended in 1874 and again in 1876, and again in 1878, which gave grants of land in certain states on condition that certain areas on these lands were planted to forest trees. Definite regulations covered the planting and subsequent care of the trees before the land patent was granted.

Later enactments did much to encourage tree planting. Among these was the Smith Lever Extension Act of 1914, by which the State Colleges and Universities carried instruction on various agricultural activities to the areas which they served. Farm forestry was included as a subject for extension instruction.

The Clarke-McNary Act of June 2nd, 1924, provided for Federal and State co-operation with land owners in the protection, development, and improvement of timbered and denuded forested land. This Act, by encouraging the appointment of technical men known as "extension foresters" to direct this work, gave an increased emphasis to the farm forestry program.

The development of the Soil Conservation Service by the Federal Department of Agriculture, which developed the program of the complete farm plan and incorporated into its program the idea of best land use, gave encouragement to farm forest development. To aid the farm planners a comprehensive forestry handbook was prepared which gave needed technical direction.

Activities encouraged by the Federal Department of Agriculture are:

Agricultural Adjustment Administration;

Farm Credit Administration;

Farm Security Administration.

These activities were organized to give financial assistance to farmers for work done in the improvement of agricultural practices, including farm forestry.

The Tennessee Valley Authority was a project set up to control water (a) in river channels, (b) on the land. The outstanding feature of this project was the development of the unit test farm, in which farm forestry was given full recognition.

An important Federal enactment was the Norris Doxey, or Co-operative Farm Forestry Act. This act was passed in 1937. Funds were made available for its enactment in 1939 for the fiscal year 1940. It recognizes the relationship between farm forestry and all other forestry work. It also provides for co-operation between the Federal Government and State agencies.

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*Study made by Joshua A. Cope, Extension Forester, New York State College of Agriculture, Cornell University, Ithaca, N.Y., under a fellowship awarded by the Charles Lathrop Pack Forestry Foundation.

The activities included are:

(1) Co-operation with states in the procurement, production and distribution of forest tree and shrub seeds and plants for farmers.

(2) Co-operation with states in maintaining intensive demonstration projects in farm forestry.

(3) Farm forestry investigations.

(4) Technical service to farmers in harvesting, marketing and utilization of farm wood products.

(5) Co-operation with states for extension activities in developing farm forestry.

In this scheme, Federal co-operation with the respective states is on a 50-50 basis, either by cash, cash in kind, or offsets. Where the states elect to meet Federal contribution with cash or cash in kind, the projects are under the direct supervision of the states, if the states' contributions are less than this the projects are Federally directed."*

This development of co-operation of all agencies which are interested in farm forestry has done much to put this work on a good basis. Under captions (2) and (4) as given above, some 135 projects have been developed in 41 states.

Some of the states have outlined the degree of co-operation between Federal and State workers and an enumeration of the services that would be available to the woodlot owner and farmer. These are referred to as the Maryland Plan, New Jersey Plan, and South Carolina Plan.

One of the later Federal activities was the Plains Shelterbelt Project, later known as Prairie States Forestry Project. This project was commenced during the drought years.

The plan was to develop a shelterbelt project on farms on a strip one hundred miles wide through six states running from the Canadian border to the State of Texas. Planting stock and technical advice was supplied by the Federal Government to intending planters. The project was financed from relief funds and was turned over to the Soil Conservation Plan when relief funds were no longer available.

Clarke-McNary Law

[Act of June 7, 1924 (43 Stat. 653), as amended]

An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture is hereby authorized and directed, in co-operation with appropriate officials of the various States or other suitable agencies, to recommend for each forest region of the United States such systems of forest fire prevention and suppression as will adequately protect the timbered and cut-over lands therein with a view to the protection of forest and water resources and the continuous production of timber on lands chiefly suitable therefor.

SEC. 2 [as amended by Act of March 3, 1925, 43 Stat. 1127, and Act of April 13, 1926, 44 Stat. 242]. That if the Secretary of Agriculture shall find that the system and practice of forest fire prevention and suppression provided by any State substantially promotes the objects described in the foregoing section, he is hereby authorized and directed, under such conditions as he may determine to be fair and equitable in each State, to co-operate with appropriate officials of each State, and through them with private and other agencies therein, in the protection of timbered and forest-producing lands from fire. In no case other than for preliminary investigations shall the amount expended by the Federal Government in any

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*Private communication from Earl S. Peirce, Acting Chief, U.S.D.A. Forest Service, Washington, D.C., Sept. 1944.

State during any fiscal year, under this section, exceed the amount expended by the State for the same purpose during the same fiscal year, including the expenditures of forest owners or operators which are required by State law or which are made in pursuance of the forest protection system of the State under State supervision and the Secretary of Agriculture is authorized to make expenditures on the certificate of the State forester, the State director of extension, or similar State official having charge of the co-operative work for the State that State and private expenditures as provided for in this Act have been made. In the co-operation extended to the several States due consideration shall be given to the protection of watersheds of navigable streams, but such co-operation may, in the discretion of the Secretary of Agriculture, be extended to any timbered or forest producing lands or watersheds from which water is secured for domestic use or irrigation within the co-operating States.

SEC. 3. That the Secretary of Agriculture shall expend such portions of the appropriations authorized herein as he deems advisable to study the effects of tax laws, methods, and practices upon forest perpetuation, to co-operate with appropriate officials of the various States or other suitable agencies in such investigations and in devising tax laws designed to encourage the conservation and growing of timber, and to investigate and promote practical methods of insuring standing timber on growing forests from losses by fire and other causes. There is hereby authorized to be appropriated annually, out of any money in the Treasury not otherwise appropriated, not more than $2,500,000, to enable the Secretary of Agriculture to carry out the provisions of sections 1, 2, and 3 of this Act.

SEC. 4. That the Secretary of Agriculture is hereby authorized and directed to co-operate with the various States in the procurement, production, and distribution of forest-tree seeds and plants, for the purpose of establishing windbreaks, shelter belts, and farm woodlots upon denuded or nonforested lands within such co-operating States, under such conditions and requirements as he may prescribe to the end that forest-tree seeds or plants so procured, produced, or distributed shall be used effectively for planting denuded or nonforested lands in the co-operating States and growing timber thereon: *Provided*, That the amount expended by the Federal Government in co-operation with any State during any fiscal year for such purposes shall not exceed the amount expended by the State for the same purposes during the same fiscal year. There is hereby authorized to be appropriated annually, out of any money in the Treasury not otherwise appropriated, not more than $100,000, to enable the Secretary of Agriculture to carry out the provisions of this section.

SEC. 5. That the Secretary of Agriculture is hereby authorized and directed, in co-operation with appropriate officials of the various States or, in his discretion, with other suitable agencies, to assist the owners of farms in establishing, improving, and renewing woodlots, shelter belts, windbreaks, and other valuable forest growth, and in growing and renewing useful timber crops: *Provided*, That, except for preliminary investigations, the amount expended by the Federal Government under this section in co-operation with any State or other co-operating agency during any fiscal year shall not exceed the amount expended by the State or other co-operating agency for the same purpose during the same fiscal year. There is hereby authorized to be appropriated annually out of any money in the Treasury not otherwise appropriated, not more than $100,000 to enable the Secretary of Agriculture to carry out the provisions of this section.

SEC. 6. That section 6 of the Act of March 1, 1911 (Thirty-sixth Statutes at Large, page 961), is hereby amended to authorize and direct the Secretary of Agriculture to examine, locate and recommend for purchase such forested, cut-over or denuded lands within the watersheds of navigable streams as in his judgment may be necessary to the regulation of the flow of navigable streams or for the production of timber and to report to the National Forest Reservation Commission the results of such examination; but before any lands are purchased by the commission said lands shall be examined by the Secretary of Agriculture, in co-operation with the Director of the Geological Survey, and a report made by them to the commission showing that the control of such lands by the Federal Government will promote or protect the navigation of streams or by the Secretary of Agriculture showing that such control will promote the production of timber thereon.

SEC. 7. That to enable owners of lands chiefly valuable for the growing of timber crops to donate or devise such lands to the United States in order to assure future timber supplies for the agricultural and other industries of the State or for other national forest purposes, the Secretary of Agriculture is hereby authorized, in his discretion, to accept on behalf of the United States title to any such land so donated or devised, subject to such reservations by the donor of the present stand of merchantable timber or of mineral or other rights for a period not exceeding twenty years as the Secretary of Agriculture may find to be reasonable and not detrimental to the purposes of this section, and to pay out of any moneys appropriated for the general expenses of the Forest Service the cost of recording deeds or other expenses incident to the examination and acceptance of title. Any lands to which title is so accepted shall be in units of such size or so located as to be capable of economical administration as national forests either separately or jointly with other lands acquired under this section, or jointly with an existing national forest. All lands to which title is accepted under this section shall, upon acceptance of title, become national forest lands, subject to all laws applicable to lands acquired under the Act of March 1, 1911 (Thirty-sixth Statutes at Large, page 961), and amendments thereto. In the sale of timber from national forest lands acquired under this section preference shall be given to applicants who will furnish the products desired therefrom to meet the necessities of citizens of the United States engaged in agriculture in the States in which such national forest is situated: *Provided*, That all property, rights, easements, and benefits authorized by this section to be retained by or reserved to owners of lands donated or devised to the United States shall be subject to the tax laws of the States where such lands are located.

SEC. 8. That the Secretary of Agriculture is hereby authorized to ascertain and determine the location of public lands chiefly valuable for stream-flow protection or for timber production, which can be economically administered as parts of national forests, and to report his findings to the National Forest Reservation Commission established under the Act of March 1, 1911 (Thirty-sixth Statutes at Large, page 961), and if the commission shall determine that the administration of said lands by the Federal Government will protect the flow of streams used for navigation or for irrigation, or will promote a future timber supply, the President shall lay the findings of the commission before the Congress of the United States.

SEC. 9. That the President, in his discretion, is hereby authorized to establish as national forests, or parts thereof, any lands within the boundaries of Government reservations, other than national parks, reservations for phosphate and other mineral deposits or water-power purposes, national monuments, and Indian reservations, which in the opinion of the Secretary of the department now administering the area and the Secretary of Agriculture are suitable for the production of timber, to be administered by the Secretary of Agriculture under such rules and regulations and in accordance with such general plans as may be jointly approved by the Secretary of Agriculture and the Secretary formerly administering the area, for the use and occupation of such lands and for the sale of products therefrom. That where such national forest is established on land previously reserved for the Army or Navy for purposes of national defense the land shall remain subject to the unhampered use of the War or Navy Department for said purposes, and nothing in this section shall be construed to relinquish the authority over such lands for purposes of national defense now vested in the Department for which the lands were formerly reserved. Any moneys available for the maintenance, improvement, protection, construction of highways and general administration of the national forests shall be available for expenditure on the national forests created under this section. All receipts from the sale of products from or for the use of lands in such national forests shall be covered into the Treasury as miscellaneous receipts, forest reserve fund, and shall be disposed of in like manner as the receipts from other national forests as provided by existing law. Any person who shall violate any rule or regulation promulgated under this section shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not more than $500 or imprisoned for not more than one year, or both.

Approved, June 7, 1924.

PUBLIC RESOLUTION NO. 13, APPROVED APRIL 13, 1926

[44 Stat. 250]

Joint Resolution Authorizing the Secretary of Agriculture to co-operate with Territories and other possession of the United States under the provisions of sections 3, 4, and 5 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture is hereby authorized to co-operate with Territories and other possessions of the United States on the same terms and conditions as with States under sections 3, 4, and 5 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor," approved June 7, 1924.

Approved, April 13, 1926.

PUBLIC RESOLUTION No. 121, 71ST CONGRESS

[S. J. Res. 183]

Joint Resolution Authorizing the Secretary of Agriculture to co-operate with the Territories of the United States under the provisions of sections 1 and 2 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Agriculture be, and he is hereby, authorized to co-operate with the Territories of the United States on the same terms and conditions as with States under sections 1 and 2 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on land chiefly suitable therefor," approved June 7, 1924.

Approved, February 20, 1931.

PUBLIC RESOLUTION No. 129, 71ST CONGRESS

[H. J. Res. 192]

Joint Resolution Extending the provisions of sections 1, 2, 6, and 7 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor," to the Territory of Porto Rico.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the provisions of sections 1, 2, 6, and 7 of the Act of Congress entitled "An Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor," approved June 7, 1924, are herewith extended to the Territory of Porto Rico, and the Secretary of Agriculture is hereby authorized to co-operate with the appropriate officials of Porto Rico on the same terms and conditions as with the States: *Provided,* That not to exceed fifty thousand acres of land may be acquired in Porto Rico under section 6 of the aforesaid Act of Congress approved June 7, 1924.

Approved, March 3, 1931.

Norris-Doxey Act

PUBLIC—No. 95—75TH CONGRESS
(Chapter 226—1st Session)
[H. R. 4728]

An Act

To authorize co-operation in the development of farm forestry in the States and Territories, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid agriculture, increase farm-forest income, conserve water resources, increase employment, and in other ways advance the general welfare, and improve living conditions on farms through reforestation and afforestation in the various States and Territories, the Secretary of Agriculture is authorized in co-operation with the land-grant colleges and universities and State forestry agencies, each within its respective field of activities, according to the statutes, if any, of the respective States, wherever such agencies can and will co-operate, or in default of such co-operation to act directly, to produce or procure and distribute forest trees and shrub planting stock; to make necessary investigations; to advise farmers regarding the establishment, protection, and management of farm forests and forest and shrub plantations and the harvesting, utilization and marketing of the products thereof; and to enter into co-operative agreements for the establishment, protection, and care of farm- or other forest-land tree and shrub plantings within such States and Territories; and, whenever suitable Government-owned lands are not available, to lease, purchase, or accept donations of land and develop nursery sites for the production of such forest planting stock as is needed to effectuate the purposes of this Act, but not including ornamental or other stock for landscape plantings commonly grown by established commercial nurserymen, and no stock grown in Government and co-operating nurseries shall be allowed to enter regular trade channels. No co-operative reforestation or afforestation shall be undertaken pursuant to this Act unless the co-operator makes available without charge the land to be planted. There is hereby authorized to be appropriated annually not to exceed $2,500,000 for carrying out the purposes of this Act. This Act shall be known as the Co-operative Farm Forestry Act.

Approved, May 18, 1937.

(*b*) *Farm Forestry in South Dakota*:*

This review is a brief summary of the forest resources of the State of South Dakota and of the work that has been done by various agencies, Federal and State, to encourage the development of tree planting and tree conservation in that State.

I. SOUTH DAKOTA A TREELESS STATE:

Raphael Zon, Director Lake States Forest Experiment Station, has this to say about South Dakota: "South Dakota is classed as one of the treeless states of the Union. The entire area of natural forests is 1,623,000 acres, or 3 per cent. of area of the state. This represents 2.5 acres of forest land per capita. Moreover, the bulk of the evergreen forest is centered in the Black Hills and the hardwoods are confined to the river and stream courses. This concentration of the natural forests in a relatively small area leaves the rest of the state practically treeless, except for some 86,000 acres which were planted by farmers."

II. TIMBER CULTURE ACT OF 1873:

In reviewing briefly the development of forestry in South Dakota, reference should be made to a number of enactments that have been passed that have as their objective the encouragement of tree planting in the Great Plains Region. A Federal enactment passed in 1873, known as the Timber Culture Act, provided that title could be given to a quarter section of land to any person who planted 40 acres of trees with a spacing of not greater than 12 feet apart each way. In 1878 this Act was amended, reducing the acreage planted from 40 to 10 acres, with the provision that 2700 trees per acre should be planted, of which 675 had to be living when the title to the land was issued. The Act was repealed in 1891. During the period it was in force it did much to encourage tree planting in the Great Plains Region, from which the State of South Dakota benefited to a considerable extent.

III. TERRITORIAL ENACTMENT OF 1869 EXEMPTING LAND FROM TAXATION:

In 1869 the Territorial Legislature passed a law exempting from taxation 40 acres of land and all the improvements thereon not exceeding $1,000 in value, provided 5 acres of land were planted to trees. The exemption continued for 10 years, provided the trees were kept in good growing condition during that time.

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*U.S. Dept. of Agric., Forest Service, in co-operation with the South Dakota State Planning Board, Lake States Forest Experiment Station.

IV. ENACTMENT OF TREE BOUNTY LAW IN 1885:

In 1885 the Territorial Legislature enacted the Tree Bounty Law. In 1889, after South Dakota became a state, the first State Legislature re-enacted this law, which has been revised but is still in force. The Law provides that anyone who plants trees and cares for them as prescribed by law is entitled to a bounty of $5.00 per acre up to ten acres each year for a period of ten years; this amount to be paid by the State Board of Commissioners of the County in which the trees are located. (Attached is a portion of this Tree Bounty Law.)

The growth in interest in this undertaking is indicated by the increase of total acreage planted. To illustrate this, 244 acres were planted in 1929 and 1324 acres in 1935.

V. BLACK HILLS NATIONAL FOREST:

The development of the National Forests, of which one is the Black Hills National Forest, located in South Dakota, has done much to stimulate interest in the conservation of trees by the introduction of methods of scientific forest management in these forested areas.

VI. NORTHERN GREAT PLAINS FIELD STATION, NORTH DAKOTA, BENEFITS SOUTH DAKOTA:

The creation of the Northern Great Plains Field Station at Mandan, North Dakota, by the Federal Bureau of Plant Industry, Department of Agriculture, has benefited South Dakota by the development of some 763 experimental co-operative plantations in the western part of the State.

VII. STATE BENEFITED UNDER CLARKE-MCNARY ACT:

The State benefited under the Clarke-McNary Act, when a State law was passed enabling the State Secretary of Agriculture to use Federal funds supplied under this Act in the procurement, production, and distribution of forest trees, seed and plants for the purpose of establishing windbreaks, shelterbelts, and farm woodlots on denuded and non-forested farm lands. Under this law 137,500 trees were sold to 506 persons in 1935.

The State also benefits under this law in the Federal assistance given in the protection of State lands against fire.

The State of South Dakota also benefited by the Shelterbelt Project inaugurated by the Federal Government in six plains states in 1934: This was later known as the Great Plains Forestry Project, and today is operated under the Soil Conservation Service.

VIII. NORRIS-DOXEY ACT SHOULD BENEFIT SOUTH DAKOTA:

The Norris-Doxey or Co-operative Forestry Act, passed in 1937 by the Federal Government became law in 1939 for the Fiscal Year 1940. Under this law the Federal Government co-operated with the State authorities in the encouragement of the development of farm forestry by the distribution of forest nursery seed and stock, and by technical assistance given in the management of farm woodlots and other farm tree plantations. South Dakota would be eligible for this assistance, as would other Great Plains States.

IX. COPY OF TREE BOUNTY ACT OF 1920*:

Section 8045: To Whom Paid—Any person who, after the year 1920, shall have planted and successfully cultivated the number of forest or fruit trees or shrubs prescribed by this article and who shall have complied with the provisions of this article, shall be entitled to a bounty of five dollars ($5.00) per acre, or not to exceed ten acres, each year for the period of ten years, to be paid by the board of county commissioners of the county in which such trees are located, out of the general fund of such county; provided that such person shall continue to comply with the provisions of this article.

Section 8046: Application for Bounty—Any person desiring to secure such bounty shall file with the county auditor, on or before the first Monday in August, a correct plan designating the land upon which the trees are planted according to the United States government survey, together with an affidavit showing the number and varieties of trees planted, the date of planting and the cultivation of the same, corroborated by the affidavits of two free holders residing in the vicinity.

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*From compiled Laws of South Dakota, 1920.

Section 8047: Number of Trees to the Acre—To secure such bounty there shall have been planted not less than 150 trees to the acre, and there shall be not less than 100 living trees per acre in any year for which such bounty is paid. Provided that any trees or shrubbery planted after July 1st, 1927, may by resolution of the Board of County Commissioners passed at the first regular meeting of such board in January of each year, be required to be arranged and planted substantially as follows:

(a) Elms, ash, black walnut, boxelder, native cedars, Black Hills spruce, oak, cottonwood, willows, or other trees of like character not herein specifically mentioned, in rows 40 feet apart and such trees 12 feet apart in each row.

(b) Russian olive and caragana in rows 30 feet apart and such trees 5 feet apart in each row.

(c) Apple trees in rows 40 feet apart and such trees 40 feet apart in each row.

(d) Plum, pear, cherry, or other similar varieties not herein specifically mentioned, in rows 30 feet apart and such trees 30 feet apart in each row.

(e) Caragana, artemisia, buckthorn, spiraea, common lilac, and other similar varieties of shrubs not herein specifically mentioned, in rows 30 feet apart and such plants one foot apart in each row.

(f) Lilac, snowball, and all other shrubs of a similar variety not herein specifically mentioned, in rows 20 feet apart and such plants 5 feet apart in each row.

(*c*) *Farm Forestry in North Dakota**:

Very little was done in the State of North Dakota in the encouragement of tree planting on the farms of the State prior to the passage of the Timber Culture Act on March 3rd, 1873.

In that same year the Northern Pacific Railway was built to the Missouri River, and it was after that date that settlement in the plains region took place west of the Red River Valley.

I. EARLY ATTEMPTS AT TREE PLANTING IN NORTH DAKOTA:

The planting of trees by the Great Northern Railway along their right-of-way to protect against snow drifting stimulated interest in the whole subject of prairie tree planting. The work began in 1905 and at the close of 1909 a mileage of 26.35 miles had been planted between Fargo and Williston, N.D., requiring 96,250 trees of different species. The earlier success with these initial plantings was satisfactory. At the end of that period (1909) the percentage living was 81.5 per cent. of all species planted.

Definite later results are not obtainable, but present indications are that the original objective is being well served.

II. FEDERAL FIELD STATION AT MANDAN, N.D.:

The establishment by the Bureau of Plant Industry of the Federal Field Station at Mandan, N.D., in 1913, has done much to encourage interest in tree planting and the distribution of planting stock for experimental and demonstrational farmstead planting in the state.

North Dakota has a School of Forestry at Bottineau, established in 1913. It also maintains a State Forest Nursery at this point, from which stock is distributed to planters throughout the state.

The state is eligible under the Clarke-McNary Law and the Norris-Doxey or the Cooperative Forestry Act for participation in the various benefits to farm forestry provided under these enactments.

North Dakota has a State Forester designated by law, and the Extension Service of the state employs an Extension Forester.

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*U.S. Dept. of Agric. Forest Service Bulletin, "Possibilities of Shelterbelt Planting in the Plains Region." Also communications from Extension Forester, Mr. John J. Zaylskie, North Dakota Agricultural College, Fargo, North Dakota.

The integrated duties within the state of these various individuals and organizations are given as follows:

III. SERVICES OFFERED BY THE NORTH DAKOTA SCHOOL OF FORESTRY:

(a) Distribution of news material:

It is agreed that the North Dakota School of Forestry will furnish such educational news value material that it has for general distribution throughout the state. This information shall include summaries of tree planting activities of the North Dakota School of Forestry as well as advance notice of availability of stock for distribution by species and number.

(b) Supply stock for farm demonstration, windbreak plantings per year in locations to be selected:

The North Dakota School of Forestry will supply free of charge, except for transportation, such tree planting stock as may be necessary for the establishment and maintenance of four demonstration windbreak plantings per year. Said windbreaks to be distributed geographically over the state (one planting per Extension District).

The planting plans to be followed in these demonstration plantings will be agreed upon by both the North Dakota School of Forestry and the Extension Service, with the responsibility of drawing up the plans resting with the Extension Forester. In the absence of a State Extension Forester, the responsibility will then rest with the North Dakota School of Forestry.

A suitable outdoor sign designating these plantings as demonstration plantings shall be furnished by the North Dakota School of Forestry. The reading on these signs shall be agreed upon by the North Dakota School of Forestry and the Extension Forester.

(c) Distribution of trees free of charge for experimental plantings:

The North Dakota School of Forestry shall furnish free of charge, except for transportation, trees for experimental plantings on a state wide basis. These experimental plantings shall be established co-operatively with the Extension Service. The size, number, type, and location shall be determined year by year, according to the needs within the state.

IV. SERVICES OFFERED BY STATE EXTENSION SERVICE:

(a) Broadcast information on tree planting and farm forestry:

Information supplied by the North Dakota School of Forestry or other agencies concerning forestry shall be disseminated on both a local and state wide system. Radio time on a minimum of four broadcasts per year shall be made available to the North Dakota School of Forestry for the furtherance of Forestry.

(b) Assist North Dakota School of Forestry in farm demonstrational windbreak plantings:

The State Extension Service shall, with the assistance of the North Dakota School of Forestry, decide on the location of the four demonstrational windbreak plantings. These plantings to be established in those areas which show the least interest in tree planting over a period of at least five years with no county receiving two consecutive demonstrational plantings. It will be the responsibility of the Extension Service to make the necessary follow-ups on these demonstrational plantings to see that they are properly maintained and to ascertain the need for replacements. The suggested follow-ups shall be on the following basis:

(c) Visit experimental plantings every five years for field inspection:

At least one visit the same year after planting is made and one visit each year for the subsequent two years and all following visits being made as often as possible with an attempt being made to visit the plantings on each fifth anniversary, such as when the planting is five years old, ten years old, and fifteen years old, so that the necessary data on tree behavior can be ascertained and recorded. Copies of the reports made on these demonstration plantings shall be forwarded to the North Dakota School of Forestry as soon as possible after the field inspection has been made.

(d) Experimental plantings to be serviced by State Extension Forester:

The various experimental plantings which are to be established throughout the state will also be serviced by the State Extension Forester on the same basis as the demonstrational plantings except in those conditions where it becomes more convenient because of location and travel conditions for the North Dakota School of Forestry to handle such service. In this case, the North Dakota School of Forestry shall furnish to the Extension Service a similar report on the planting.

(e) Assist the State School of Forestry in the formulation of tree planting plans for farmers:

The State Extension Service shall in the future, as in the past, assist in the dissemination and distribution of tree order blanks for the North Dakota School of Forestry and upon demand by the farmers shall, where practical, assist them in the formulation of tree planting plans.

(f) Extension Forester to make information available to State Forester:

The Extension Forester shall make available to the North Dakota School of Forestry such educational and factual material as the State Forester may request. Likewise, he shall make available copies of all forestry information such as news article, circulars, and bulletins which the Extension Service may publish.

(g) General:

1. It is mutually agreed that any state wide recommendations of tree planting policies will first be submitted to the members of the State Farm Forestry Committee for correlation and criticism before they are submitted for distribution to the public.

2. There will be reciprocal assistance given in miscellaneous matters such as seed collection, seed and tree distribution to 4-H and other similar groups, the propagation of untried but apparently desirable species of trees, and other items of interest and benefit.

3. This agreement may be terminated by either the State Forester or the State Director of Extension upon thirty days prior notice in writing. It may be amended by mutual agreement of the signatories to the agreement.

(*d*) *Farm Forestry in Minnesota:*

In regard to the farm forestry situation in the State of Minnesota, a brief summary is made of the situation as it exists today in the hardwood and prairie district of that state.*

I. MINNESOTA REPRESENTS FOUR FOREST ZONES:

In getting a background of the situation as it exists in Minnesota it may be pointed out "that Minnesota lies at the convergence of four natural zones: the northern coniferous forest of Canada, the northern hardwoods forest of Michigan and Wisconsin, the oak forest of the Central States, and the grasslands of the Great Plains."

"The hardwood district embraces a grassland area of 11,356,000 acres, the prairie district 20,852,000 acres. Together, the two comprise two-thirds of the area of Minnesota.

"The hardwood and prairie districts of Minnesota are primarily an agricultural region and as such contrast markedly with the northeastern forest region."

Early settlers in southern and western Minnesota found half of the land in forest and half in prairie. Most of the untimbered district, including the headwaters of the Minnesota and Red Rivers, consisted of tall grass prairie.

The northwestern counties bore a mixed tree growth. Open bogs and brush prairie intermingled with stands of spruce and tamarack. Along the river bottoms were stands of cottonwood, boxelder, green ash, silver maple and elm.

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*Economic Notes No. 6, July, 1937: "The Forest Situation in the Hardwood and Prairie Districts of Minnesota," Lake States Forest Experiment Station, Univ. Farm, St. Paul, Minnesota, U.S.D.A. Forest Service.

"These prairie-border and bottomland forests originally occupied about one-quarter of the entire area of the prairie district, but the standing volume of timber probably did not exceed five billion feet.

"Of the entire area of the hardwood district about 80 per cent. was originally forested. This original stand totaled possibly thirty billion board feet."

II. FOREST GROWTH IN HARDWOOD AND PRAIRIE DISTRICTS OF MINNESOTA IS LARGELY FARM WOODLANDS:

"Today, of the 32,208,000 acres of land in the hardwood and prairie districts of Minnesota, 4,161,500 acres or 13 per cent. is now natural woodland, and 86,300 acres, or one-quarter of one per cent. consists of planted shelterbelts. Since seven-eighths of the total land area and four-fifths of the woodland are contained in farms, forestry is essentially a woodlot proposition."

The bulk of the farm woods are in a very poor condition. This condition is no doubt due to overcutting and over pasturage. Among the survey findings the following stand out rather prominently to illustrate the present condition of woodlots and shelterbelts in Minnesota.

III. PRESENT CONDITION OF WOODLOTS AND SHELTERBELTS AS SHOWN BY SURVEY FINDINGS:

1. In spite of the large demand for wood in the Hardwood and Prairie districts of Minnesota, and in spite of the recognized need for woodlands for timber production, game conservation, soil protection, and as windbreaks, most forest lands in these districts are being badly managed.

2. Only one farm woodlot out of one hundred in the Hardwood district is well managed for sustained yield. Eighty-five per cent. are more or less pastured, and 36 per cent. have been so heavily grazed that they retain only a few scattered scrubby trees.

3. Planted shelterbelts in the Prairie district are likewise in bad condition. Only one farm out of twenty-five has a really good plantation. Fourteen per cent. of the farms have no protection from trees, and 58 per cent. more have very meagre protection. Poor planting, poor selection of species, lack of cultivation and care, premature cutting, grazing, and drought have left most shelterbelts in a deplorable condition.

Shelterbelts

Historically, the beginning of the shelterbelt planting in Minnesota dates back to the earliest settlement of the prairie portions of the state.

BEGINNING OF TREE PLANTING IN MINNESOTA

Some encouragement to tree planting was given in the prairie portions of the state by the passing of the Timber Culture Act in 1873 and the Kincaid Amendment of 1911. Coupled with this is the general desire to have trees growing around homes. Shelterbelts were planted during the period of heaviest settlement from 1880 to 1900.

These earlier plantings were of quick growing species like the cottonwood, willow, soft maple and boxelder, procured largely from the river bottoms. Although these trees made a rapid growth at first, they are now, after 30 to 50 years, showing the effects of drought conditions and are beginning to die from the tops.

Crowding and extreme atmospheric drought have had their effect and in 1934 and 1936 have had damaging effects on the trees.

Minnesota, as a state, has done very little to encourage shelterbelt planting in the prairie portions of the state. It has not co-operated with the Federal Government under the Clarke-McNary Act in tree distribution as many states have done.

Some recent work done by the Division of Forestry, University of Minnesota, from the years 1920 to 1927, in the planting of 320 demonstration shelterbelts has given information of value in the management of these plantations in that state. Such questions as: The survival of different kinds of trees; influence of soil on tree survival; rates of growth; and influence of spacing and thinning on tree survival were studied.

SUMMARY OF STUDIES WITH DEMONSTRATION SHELTERBELTS

Summarizing briefly, the following findings were obtained:

Of 25 species planted only 17 occurred in sufficient quantity to give reliable data.

The survival of four species, namely, *green ash, boxelder, American elm* and *caragana* was 45 per cent. or more 13 to 15 years after the original belt was started. The survival of green ash and boxelder was 70 per cent. Green ash was found to be the best tree to plant in the region studied.

Evergreen trees showed significantly lower survival on the heavier clay soils than on the lighter soils of a sandier nature.

Two of the most important causes for the poor condition are grazing by livestock and lack of cultivation.

APPENDIX 8

THE CHARACTERISTICS OF "POPLAR BLUFFS," AND METHODS OF MANAGEMENT ADAPTED FOR THEIR IMPROVEMENT

The characteristics of the so-called "poplar bluffs" of the prairie-aspen grove region, and the various methods by which they may be improved for farm woodlot purposes are presented in the following outline by C. B. Gill, Senior Forest Engineer, Department of Mines and Natural Resources, Manitoba.

Poplar Bluffs:

Many of our Manitoba woodlots are composed of the one species, aspen or white poplar. This tree reaches large size in the forest belt but is apt to be of scrubby habit, poor form, and very subject to disease in the prairie and aspen grove belt. There is considerable evidence in support of the theory that the height and general health of aspen depend largely on the soil reaction of the site. Aspen does best on soils where the pH value is from 3.8 to 5.5, i.e., distinctly on the acid side. This condition is rarely met with in the prairie and aspen grove belt.

Be this as it may, the fact remains that many of the poplar woodlots outside the forest belt are in very poor condition. This has been particularly noticeable during the last 15 years, and was no doubt accentuated by the general drought of the period 1929 to 1940. The poplar canker has done widespread damage of recent years. This is a fungus disease which kills the cambium layer and results in the death of that part of the main trunk or branch above the point where the disease first establishes itself.

The other poplars, such as the so-called Russian poplars, our native cottonwood and the balsam or black poplar are able to thrive on more alkaline soils. The Russian poplars sometimes reach a great size in a remarkably short time, but their wood is much inferior to white poplar and they are short-lived. The cottonwood is by far the best of the poplar group as far as size and general health goes, but its wood is inferior to white poplar for fuel purposes. The black poplar requires moist sites and its wood is not so suitable for fuelwood.

One may ask why the aspen is so ubiquitous throughout the agricultural region of Manitoba, if soil and climatic conditions are not optimum for its best development. The answer seems to be in its peculiar habit of reproduction. A study of poplar 'bluffs' will show that in nearly all cases the trees originated from the root-suckers of older trees and not from seed. This may be noted by pulling up young trees or digging trenches along the roots of older trees. Farmers in the aspen grove belt will have noted that root-suckers from adjacent groves of trees will result in new shoots coming up along the edge of the fields (and that the spread of the grove is prevented only by culture). None of our native or introduced trees have this habit, although it is fairly common among the shrubs such as saskatoon, hazel, plum, cherry, lilac and some shrub willows. These shrubs, however, spread rather slowly, while aspen suckers will result in new trees as far as two or three rods from the parent tree.

The new trees resulting from root-suckers have been reproduced asexually and have only one parent. The poplars are dioecious, that is, the male and female flowers or catkins are borne on separate trees. Observations, made in the spring when the catkins are in evidence, will show that many small groves consist entirely of staminate flowers, while others are entirely pistillate. This indicates very clearly that the whole grove originated from one tree. If the trees had originated from seed, the number of male and female trees would have been more or less equal, and well distributed.

Statistical methods can be easily applied to data of this kind. Assuming that the number of male and female seeds produced is equal, and the number of trees in a grove is 20, all of which are male or all female, it can be shown that the chances of all these trees having originated from seed are one in 1,048,576. The situation, as a matter of fact, is similar to that of tossing 20 coins and estimating the chances of having them all come up heads or all tails.

It is true that some aspen must occasionally grow from seed, but this happens very rarely. The seed is produced in large quantities, but is very small and retains its vitality for a very short time. It must find a surface of fresh mineral soil, kept continually moist for some time, at least until the young root gets established. This set of conditions is hard to find in the region under consideration. It will occasionally become established from seed in slough bottoms, exposed by dry years, but trees started in this situation are likely to be drowned out when the water levels come back to normal.

On the other hand, aspen originating from root-suckers makes very rapid growth. In burned-over or cut-over areas, young shoots may reach a height of six feet or more by the end of the first summer. Measurements on cut-over areas in the Turtle Mountain give an average of five feet in the first two years after cutting.

Other broad-leaved trees such as cottonwood, Russian poplar, the tree willows, maple, birch, basswood and oak grow readily from the stumps of trees which have been burned or cut down, but they do not cover the ground nearly as fast as aspen does and hence are at a disadvantage when competing with aspen. Ash and elm will also sprout, especially from young stumps, but do not appear to be as vigorous in this respect as some of the other broad-leaved trees.

Nearly all natural woodlots and forest areas contain at least some aspen. After cutting or burning the widespread lateral roots of the aspen send up numerous shoots which rapidly develop into new trees and tend to choke out the slower-growing shoots of the other broad-leaved trees, which are at the further disadvantage of being located only close around the edge of the stump. The coniferous trees such as white spruce are at a still greater disadvantage because they do not grow either from root-suckers or old stumps, but only from seed.

Fire and frequent cutting thus favours aspen rather than the longer lived broad-leaved trees or the conifers. Prairie fires were common and widespread previous to and during the period of settlement. Even at the present time fires in farm woodlands are much too frequent.

Young aspen stands are usually vigorous and healthy in their early years even when growing on relatively alkaline soils of the prairie region. They tend to deteriorate with age, and thus before the trees reach a size suitable for the production of large logs they succumb to disease, insect damage, or drought; all these causes being accentuated by the unfavourable soil conditions. To make good saw-logs or even better quality fuelwood bolts, aspen should be from 45 to 60 years of age. Trees of this age when growing in the forest region are usually reasonably healthy, but such is not the case in the average grove on the farms of southern Manitoba. Conditions are, however, more favourable in areas like the Turtle Mountain and the Pembina Hills, where the continued growth of forest has gradually developed a soil more favourable to trees.

Introducing Trees of Greater Value:

In case it is decided to introduce new species, these should be trees which experience has shown to be capable of growing and thriving in the district in question. Usually these will be species native to the district or at least native to an adjoining district. However, certain trees introduced from other countries where climatic conditions are similar and which have been grown here for some years will have to be considered.

The most likely native trees are green ash, bur oak, white elm, birch and cottonwood among the broad-leaved trees, and white spruce, tamarack and jack pine among the conifers. Introduced conifers which give promise of success are Scots pine, lodgepole pine and Siberian larch. The native basswood may be grown successfully in the Red River Valley and on the east slope of the Pembina Hills. The Manitoba maple is easily introduced but is short-lived and rather crooked.

New trees may be established in woodlots, either by planting in bare areas, or by introducing the new trees into existing woodlots. We have had considerable experience in planting on bare areas of grassland and on fields previously cultivated. All the species mentioned above have been grown in plantations in Manitoba or in eastern Saskatchewan.

When tree species are introduced into new areas their adaptability to the new site may best be measured by noting whether they are able to reproduce themselves successfully in the second generation and thus become thoroughly established in the new environment.

In the case of coniferous plantations, put in by planting on previously bare areas, some very interesting observations have been made on natural regeneration from seed.

At Morris, on Red River soils, a spruce plantation planted in 1906 is now successfully extending itself in a narrow strip along the north side and is also producing some seedlings in natural openings in the plantation. The parent trees have reached a maximum height of around 50 feet.

At Camp Hughes, on Stockton sand soil, a Scots pine plantation, 4.4 acres in extent, established in 1906, is now extending itself in a strip about 21 feet wide on the north side where moisture conditions are favourable. White spruce, from naturally grown trees in the vicinity, is also becoming established on the north side of the pine plantation and inside the plantation where blank spaces occur. The pine plantation is now over 50 feet high and some of the trees are beginning to reach saw-log size.

A white spruce plantation on the Turtle Mountain, established by planting in 1912, is now extending itself by natural seeding on the north side and in blank spaces within the plantation. The nearest naturally grown spruce is about 50 miles away.

Reproduction, in sheltered positions, from clumps or rows of white spruce has also been observed on the Gretna clays and Newdale soils, and no doubt occurs to some extent on other blackearth and northern blackearth soils.

In the case of broad-leaved trees there has been a considerable amount of spreading by seed, as the result of breaking up the soil in the course of settlement, and thus furnishing a favourable seed-bed. Cottonwood has been observed to spread in this way on normal position soils of the Red River Valley. This tree is also spreading on Souris sands and to a lesser extent on Stockton sands, where the surface soil has been removed by wind erosion. Manitoba maple has often spread by seed from single trees or farmstead shelterbelts and has to some extent invaded poplar bluffs.

Improvement of Woodlots:

In planning the improvement of existing woodlots, most of which are poplar, three methods offer themselves, as follows:

1. The improvement of the existing stand by better fire protection, the elimination of grazing by livestock, better silviculture and cutting methods.

2. Removing the whole of the existing stand and replanting with other species, taking care to eliminate poplar root-suckers as they spring up from the old lateral roots.

3. The introduction of a limited number of superior trees, and handling the woodlot in the future, so as to encourage the natural spreading of the new species, with the idea of either completely replacing the poplar eventually or of producing a mixed forest in which a certain amount of poplar is left.

1. IMPROVEMENT OF EXISTING STANDS WITHOUT THE INTRODUCTION OF NEW SPECIES:

With regard to the first alternative, there can be no doubt that a good deal can be done to improve existing poplar bluffs. Ground fires often cause scars on trees, and these scars are very apt to allow the entrance of the false tinder fungus Fomes igniarius, which does very widespread damage to aspen. Spring fires which are prevented from entering the bluff by the wet condition of the ground are very apt to destroy those young trees around the margins, which if left alone would increase the woodlot area.

Grazing by cattle and horses in woodlots is another important cause of deterioration. The main damage in this case is from tramping the soil, causing it to become too compact, in fact just the opposite of a proper 'forest floor,' which is quite loose. Young seedlings and undergrowth are killed by pasturing livestock, and the ground is left open to drying winds. Grass invades the woodlot and conditions soon become unfavourable for the establishment of the young trees which are needed to carry the woodlot into the next generation.

The best method of cutting in a poplar forest is the clear-cutting system. First the rotation is decided, i.e., the number of years which the trees are expected to take to reach maturity, and then each year an area is cut, of such a size that at the end of the rotation the whole woodlot will have been cut-over. For example, poplar will produce fair fuelwood in 40 years; in this case 1/40th of the area is cut each year. The cut-over area will readily reproduce itself from root-suckers and at the end of 40 years the woodlot will consist of 40 different plots, ranging in age from one to 40 years.

In addition to clear cutting the annual area, it will be very desirable to go over the whole area yearly, removing diseased trees. The poplar canker should be especially guarded against. Any tree infected with it should be removed as soon as possible so as to prevent infection of other trees. The practice of going over the whole area annually and removing the largest and healthiest trees is not a good one, as it leads to a gradual deterioration of the woodlot.

White poplar has become recognized as a satisfactory firewood. There is some possibility that it will in the future have a value as pulpwood. Certain soil areas, such as the Almasippi sands, the Pembina Hills soils, and some of the Firdale and Newdale soils are producing fair poplar timber at the present time. It so happens that these same areas are quite capable of producing other trees, and it seems to be desirable to introduce new species which are of generally greater value, into at least a part of the woodlots.

2. COMPLETE REPLACEMENT OF POPLAR BY OTHER SPECIES:

Some of the poplar woodlots have deteriorated to such an extent, especially during recent years, that it may be considered desirable to eliminate them completely and to plant new species.

One method of accomplishing this would be to cut the remaining timber, break up the land, remove the roots, and if necessary crop it for a few years and then replant. In this case it would be likely necessary to go over the plantation at the end of the first year, cutting back any poplar shoots which interfered with the newly planted trees. Similar work might be necessary at intervals during later years, or until the new trees finally overtopped the poplar shoots.

Another method would be to use what has been called the 'corridor system.' By this method all trees and brush would be cut out in strips about four feet wide, leaving intervening strips about 16 feet wide uncut. The corridor would then be planted or seeded to some other species such as white spruce, green ash, Scots pine or bur oak. The intervening strip would be left as it was, and would serve as protection to the trees in the 'corridor.' As the new trees developed, the trees on the intervening strips would be gradually removed, taking care that the ground be kept sufficiently shaded to prevent grass coming in. The intervening strips would gradually seed in to the new species.

Care would have to be taken to prevent the new poplar shoots which would come up on the cleared strip from choking out the slower growing new trees. It would probably be necessary to cut these out with a scrub scythe each year for several years.

The method of underplanting poplar with other species has not proven satisfactory to date. The poplar shade and possibly root competition has been too severe for the underplanted trees to make any progress. Experiments made on the Riding Mountain, Duck Mountain and Spruce Woods show that white spruce, underplanted in poplar stands will eventually die, except where natural or artificial openings are made to let in light. The experiments also brought out the fact that spruce has a remarkable power of survival in shaded conditions. In one case a spruce plantation under a semi-mature poplar stand survived for 18 years after planting, making practically no growth at all. The over-storey of poplar has now been removed and there is little doubt that the growth of the spruce will be accelerated.

Even after removing the poplar over-storey, it may be necessary to cut back the poplar shoots which are likely to spring up from the roots, and this operation may have to be repeated at intervals until the new underplanted trees have overtopped the poplar.

The lesson appears to be that poplar can be successfully underplanted with other species only if constant attention is given to the latter, paying particular attention to the removal of poplar trees and shoots so as to give a fair amount of light to the new trees.

3. INTRODUCTION OF A LIMITED NUMBER OF NEW TREES, AND HANDLING THE WOODLOT AS A MIXED FOREST:

The section on "Poplar Bluffs," points out how fire and frequent cutting encourage poplar, particularly aspen or white poplar. Foresters speak of poplar as a cover type or temporary type. It seems to be true in Manitoba, as elsewhere, that poplar tends to disappear and be replaced eventually by what is called a permanent type, provided no cutting or fire takes place. For example, certain groves of trees in the Portage la Prairie area, which have been protected from fire for many years by virtue of the surrounding land being under cultivation are now almost 100 per cent. bur oak.

This same gradual progression towards the elimination of poplar has been noted in other places. Unfortunately, much of this change has resulted in the replacement of poplar bluffs by shrubs and small trees of no wood value, such as hazel, hawthorn, saskatoon, cherry, etc. The reason for this change in the wrong direction indicates the lack of sufficient seed trees of the right kind. The natural change, away from poplar, can be directed into better channels by a little help on the part of the owner of the woodlot.

The most obvious improvement is to aid any superior trees which have become established naturally, for example, oak, or ash, by slashing the tops of inferior trees or shrubs which are overtopping them, thus giving the favoured trees an advantage.

In most cases, however, it will be necessary to introduce some new species, by planting, or seeding. One of the easiest ways to do this is by planting a few trees in natural openings or small openings made by removing mature or diseased poplar. The north side of a poplar bluff is also a good place to plant. It will be necessary to prepare a seed bed a foot or two wide around each tree planted. If sod is present this should be removed bodily, using a grub hoe. In some cases it will be possible to run a few furrows through the woodlot, using a scrub breaker and a tractor. In this case the new trees are planted in the bottom of the furrow. As the newly planted trees develop, overhanging limbs or whole trees of the old stand should be eliminated, and fresh shoots from poplar roots cut back.

After the newly established trees, preferably ash, oak, spruce, tamarack or pine are old enough to produce seed, ground conditions may have become favourable enough for the seed to be able to successfully germinate and establish itself as a younger generation under the original poplar stand. If seed bed conditions are not favourable, seed spots should be made at the time of seed-fall by removing grass, herbs, or shrubs at intervals around the seed trees. When the new seedlings become established it will still be necessary to observe them occasionally and to remove competing trees, shrubs or shoots which tend to over-top them.

By the method outlined above it will be possible to introduce new species into a poplar stand without any great amount of work at any one time. The process will change the woodlot from a pure poplar stand to any mixture desired, depending on which trees are favoured. If at any time it is desired to increase the percentage of poplar, all that is necessary is to clear-cut a part of the area, and allow fresh poplar root-suckers to develop.

The method outlined above, gradually changing the composition of a woodlot, has several advantages over the other methods outlined earlier.

APPENDIX 9

WOOD PRODUCTS FROM THE MANITOBA FARM WOODLOT

By C. B. Gill

The most obvious value of a farm woodlot is in connection with its production of wood or timber for use on the farm or for sale. Perhaps the most important forest product to the average farm is fuelwood. The relative fuel value of the different trees native to Manitoba is shown in table No. 8, entitled "Heating Value of Wood Fuels." The reader should observe that the values refer to completely air-dried wood, and the sticks are as near as possible of the same size, shape and rate of growth. This will explain the values of black poplar and elm, which are often thought to be of relatively low value for fuel purposes. These two trees being somewhat cross-grained are difficult to split and hence difficult to dry.

Another important forest product which every farm requires is a supply of fence posts. Tamarack, cedar, oak and green ash are probably the most valued for this purpose. The native willows are very durable, although they are apt to be small and crooked and best used alternately with other species. Other species, such as poplar and spruce which are short-lived when untreated, may be made into very useful posts, if properly treated so as to prevent decay.

The strength and durability of a fence post depends to a considerable extent on the width of the annual rings. Young, fast growing trees have wide rings, with a large proportion of spongy spring wood, while older or slow growing trees have narrow rings and have a larger proportion of close grained fall wood. This explains why a slow growing black spruce may produce a better post than a fast growing tamarack. In the case of tamarack, the old, slow growing trees from the muskeg are much more durable than trees of equal or larger size which have grown on higher, or better drained land.

Small, straight poles have many uses on the farm, especially in the making of gates, racks, roof-poles, and repairs to machinery. Ash, tamarack or spruce will be valuable for these purposes. A properly managed woodlot will supply these small poles as thinnings, the remaining trees being left to grow.

If at all possible, the larger, straighter logs should be taken to a local saw-mill and sawn into lumber. White poplar, black poplar, cottonwood and elm sawn into planks will be found useful in the stable in building or repairing mangers and stalls. Spruce, pine and tamarack may be sawn into boards or dimension stock and used for any type of building. Oak should usually be reserved for repairs to implements and furniture.

There is an ever increasing demand for pulpwood. Spruce has been the standby for this purpose, but there is an ever increasing demand for balsam fir, poplar and jack pine. Under careful management, the better woodland soils will yield very nearly one cord per acre per year of pulpwood in perpetuity.

TABLE NO. 8—HEATING VALUE OF WOOD FUELS

This table shows the approximate amount of wood in cords necessary to produce the same heating effect as a ton of American anthracite. Computations are based on split wood, with a moisture content of 20 per cent. of the gross weight, and containing 90 cubic feet of solid wood.

Species	Amount (in cords) of wood required to give equal heating effect of 1 ton American anthracite coal
Green Ash	1.42 to 1.70 cords
Basswood	1.85 to 2.22 "
Paper Birch	1.34 to 1.60 "
Cottonwood	1.87 to 2.25 "
White Elm	1.28 to 1.54 "
Manitoba Maple	1.63 to 1.95 "
Bur Oak	1.15 to 1.34 "
White Poplar	1.77 to 2.13 "
Balsam Poplar	1.83 to 2.19 "
Cedar	2.30 "
Balsam Fir	2.40 "
Tamarack	1.50 "
Jack Pine	1.75 "
Lodgepole Pine	1.85 "
White Spruce	2.05 to 2.30 "
Black Spruce	1.60 to 2.00 "

NOTE: Figures supplied by Forest Products Laboratory of Canada.

APPENDIX 10

FOREST PRODUCTS PRODUCED ON MANITOBA FARMS IN PRE-WAR YEARS

The forest and woodlot products harvested on Manitoba farms include firewood, fence posts, rails, saw-logs, railway ties, telegraph and telephone poles, pulpwood, etc. The quantities of these woodlot products produced annually on Manitoba farms under pre-war conditions are indicated by the data for the respective census divisions, given in the Dominion Census Report for the year 1931.

Table No. 9—Summary Table of Firewood, Fence Posts, Rails, Lumber, Railway Ties, Telephone and Telegraph Poles, and Cords of Pulpwood, produced annually on Manitoba Farms, under pre-war conditions (according to Census of Canada, 1931)

Census Division		Cords of Firewood			Number of Fence Posts			Number of Rails			Lumber in M. ft. B.M.			No. of Railway Ties Sold*	No. of Telegraph and Telephone Poles Sold	No. of Cords of Pulpwood Sold
No.	Name**	Used*	Sold†	Total	Used*	Sold†	Total	Used*	Sold†	Total	Used*	Sold†	Total			
1.	South Eastern	27,328	26,594	53,922	28,572	7,194	35,766	7,320	...	7,320	374	215	589	4,946	40	5,051
2.	Red River (South)	13,108	3,353	16,461	49,686	14,850	64,536	1,450	...	1,450	105	4	109	210	..	...
3.	South Central	21,077	3,487	24,564	109,634	27,195	136,829	2,820	...	2,820	...	1	1	...	..	...
4.	South West	4,811	1,835	6,646	21,853	8,968	30,821	300	...	300	...	...	...	...	..	...
5.	Whiteshell	23,728	10,802	34,530	18,781	350	19,131	3,375	320	3,695	157	75	232	...	..	2,652
6.	Red River (North)	12,334	4,689	19,023	42,399	3,700	46,099	1,560	700	2,260	5	...	5	...	..	...
7.	Carberry	19,356	2,848	22,204	112,105	10,237	122,342	2,000	...	2,000	40	5	45	...	40	...
8.	Virden	16,877	2,883	19,760	57,445	4,620	62,065	225	...	225	...	...	...	...	..	...
9.	Stonewall	14,024	2,777	16,801	23,103	3,610	26,715	1,480	...	1,480	105	1	106	...	..	...
10.	West Lake	11,918	2,592	14,510	33,572	3,675	37,247	660	...	660	11	...	11	...	..	12
11.	Shoal Lake	35,345	3,995	39,340	62,794	1,745	64,539	1,210	...	1,210	35	2	37	...	..	41
12.	Inter-Lake	35,687	20,000	55,687	48,360	400	48,760	9,751	...	9,751	326	88	414	...	..	2,057
13.	Lake Dauphin	18,433	1,493	19,926	22,506	100	22,606	4,908	...	4,908	87	15	102	...	..	237
14.	Russell	40,459	4,995	45,454	81,418	3,705	85,123	1,485	...	1,485	417	72	489	750	..	1,130
15.	Swan River	11,402	1,607	13,009	7,325	1,400	8,725	4,440	...	4,440	168	3	171	60	..	...
16.	Unorganized	12,808	3,328	16,136	12,935	1,350	14,285	7,915	...	7,915	455	9	464	...	..	652
	Totals	320,695	27,278	417,973	732,488	93,099	825,587	50,899	1,020	51,919	2,285	490	2,775	5,966	80	11,832

*Used on the farms.

†Sold from the farms.

**These names are not an official designation but are inserted to give an idea of the location.

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